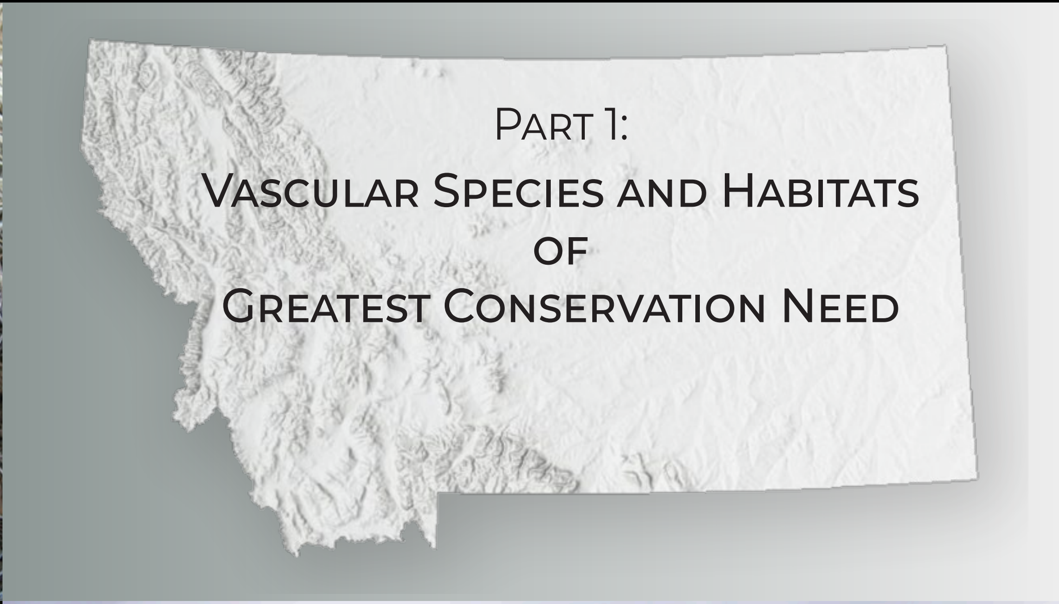
MONTANA NATIVE PLANT CONSERVATION STRATEGY



PART 1:

VASCULAR SPECIES AND HABITATS
OF
GREATEST CONSERVATION NEED

RECOMMENDED CITATION

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The *Montana Native Plant Conservation Strategy: Vascular Species and Habitats of Greatest Conservation Need* was made possible by a large partnership of people representing federal and state agencies, Tribal nations, non-profits, non-governmental organizations, academia, and as individuals. The level of participation greatly varied and is generally reflected by these categories:

Core Team Members [C]: Writers, editors, and content builders who developed the *Strategy*. Lead Editor [E] served also as the project manager.

Representative Partner for their Organization [R]: Professionals who were formally appointed by their organization to serve in the larger Partnership that was to guide and develop the *Strategy*.

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Participant [P]: Non-appointed professionals who participated in scheduled meetings on behalf of their organization or as an individual who gave help or information for the *Strategy*.

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- Criteria, Species, & Habitats S
- Strategy Content S
- Montana Herbaria S
- Centennial Valley Sand Dunes W
- Metamorphosed Limestone W
- Quaking Aspen (*Populus tremuloides*) Plant Community W
- Sapphire Rockcress (*Boechera fecunda*) W
- Spalding's Catchfly (*Silene spaldingii*) W
- Ute Ladies'-tresses (*Spiranthes diluvialis*) W
- Water Howellia (*Howellia aquatilis*) W
- Whitebark Pine (*Pinus abicaulis*) W

Table 1. Montana Native Plant Conservation Strategy partnership. The affiliation and roles of people who from 2018 to 2024 assisted, at some level, in developing the Strategy. Their level of assistance varied greatly, but was always beneficial.

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A NOTE ON CAPITALIZING PLANT NAMES

The *Montana Native Plant Conservation Strategy* follows the philosophy of capitalization used by Robin Wall Kimmerer to convey the names of plants, people, animals, and other living beings in her book *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge, and the Teachings of Plants* (2013).

Names matter. They help form identity for each person and the numerous living beings around us. They carry deep personal, cultural, familial, and historical connections. Names also create a level of distinction, reflect the way we view living beings, and affect how we communicate to, with, and about these beings. We accept the convention that a proper noun - that which serves to name a specific place, person, or thing - be capitalized. Biologists have also generally accepted that common names for plants are not capitalized unless they represent a human being's name or other official name. Thus, Ponderosa Pine Lodge in reference to a registered business is capitalized, but ponderosa pine as a species of tree is not capitalized.

Plants go by many names. The study of biology devised the scientific name, a formal system for naming species, that is also used to classify and understand relationships (ancestral and hereditary) among different organisms. Based in Latin, the scientific name made it possible for people to communicate about a particular type of plant and its relatives (family, genus, variety, etc.) across languages. Though handy, scientific names are most easily used and understood by people with a background in the biological sciences.

Across a specific plant's distribution, its numerous characteristics often vary, and it is encountered by people of differing communities (culture, heritage, regional, etc.). Hence, people and their culture, heritage, or desire to pay tribute will give to plants other names – a common name. Many common names for the same plant arise – often reflecting the plant's use, value, trait, place of origin, omen, or other significant association developed by those in community. Though we refer to these given names as being "common", they are nonetheless as important for conveying information and being understood by the people and the community where they originate.

Names matter whether they arise from a formal, scientific process or evolve in relationships with people of community. In this *Strategy*, words like Paintbrush, Woolly, Beardtongue, and Pine are capitalized when referring to a species, and are in lower case (paintbrush, woolly, beardtongue, and pine) when describing a category or concept.

PHOTO & DRAWING CREDITS FOR COVERS AND SECTION TITLE PAGES

Front Cover: *clockwise from top left photo*

- A fritillary butterfly species rests on the flower of an aster (Symphyotrichum sp.). Photo Credit: Connie Geiger.
- Autumn in Glacier National Park: Western Larch (*Larix occidentalis*) forests and snowy mountainous habitats in northwestern Montana. Photo Credit: MTNHP staff.
- Grasslands with Two-Grooved Milkvetch (*Astragalus bisulcatus*) on the Charles M. Russell National Wildlife Refuge. Photo Credit: Dee Blank.
- Sparrow's-egg Lady's-slipper (*Cypripedium passerinum*). Photo Credit: Bruce Selyem.
- Bitterroot (*Lewisia rediviva*), Montana's state flower, on BLM lands near Butte, Montana. Photo Credit: Scott Mincemoyer.

Executive Summary:

Pen and ink sketch of the Brittle Bladder Fern (*Cystopteris fragilis*) drawn by Elizabeth Bergstrom.

Section 1:

Remediation of the Clark Fork River – 2014 – MTDEQ, NRDP, and CFRTAC. Mine waste was removed from the river's floodplain. Dirt and alluvium rock were used to reconstruct the floodplain. Microtopography (woody debris) created roughness for native seed. Native aspens, cottonwoods, birch, alders, and willows were planted and fenced to protect them from wildlife browsing. Photo Credit: Andrea Pipp.

Section 2:

Blanchard Lake in the Flathead Valley, Montana. Photo Credit: Dee Blank.

Section 3:

Red Mountain in Glacier National Park, Montana. Photo Credit: Dee Blank.

Section 4:

Granite Creek Trail winds through an old-growth forest in the Cabinet Mountains, Montana. Photo Credit: Dee Blank.

Section 5:

Swan River National Wildlife Refuge in Swan Valley, Montana. Photo Credit: Dee Blank.

Section 6:

Open Sagebrush steppe habitat with Lemhi Beardtongue (*Penstemon lemhiensis*), grasses, and forbs at the Big Hole National Battlefield, Montana. Photo Credit: Andrea Pipp.

Section 7:

An undergraduate student working in the herbarium and wheat breeding lab at Montana State University shows off plant specimens. Photo Credit: Matt Lavin.

Section 8:

Sleeping male mining bees (*Anthophora montana*), Daybreak Ranch, South Dakota. Photo Credit: ©WWF-US / Clay Bolt.

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Photo A-1 (front): Sapphire Rockcress (*Boechera fecunda*) in Beaverhead County, Montana. Photo Credit: Jessie Salix

Photo A-2 (front-back): Yellow blooms of Thickleaf Bladderpod (*Physaria pachyphylla*) plants, Montana. Photo Credit: Andrea Pipp.

Appendix B:

Photo B-1 (front): Metamorphosed Limestone Unique Habitat in the Canyon Creek Gorge, Montana. Photo Credit: Andrea Pipp.

Photo B-2 (back): Native plants in the alpine habitat of Glacier National Park, Montana. Photo Credit:Tara Luna

Appendix C:

Photo C-1 (front): A sagebrush community on the Charles M. Russell National Wildlife Refuge, Montana. Photo Credit: Dee Blank.

Photo C-2 (back): Western Montane Grasslands, a Plant Community of GCN. Montana State Trust Land near Lost Trail National Wildlife Refuge. Photo Credit: Dee Blank.

Appendix D:

Photo D-1: A Curatorial Assistant for the University of Montana Herbarium mounts plant specimens collected by Peter Stickney. Photo Credit: Andrea Pipp.

Appendix E:

Photo E-1: At the Lewis & Clark Library, people can learn about plants and discover what grows on Mount Helena City Park – an undeveloped parkland in Helena, Montana. Donated by the MNPS-Kelsey Chapter, the cabinet houses preserved plant specimens, collection data, and natural history information which complements what is found in the bookstacks and digital library. Photo Credit: Andrea Pipp.

Back Cover: *clockwise from top left photo*

- Giant Helleborine (*Epipactis gigantea*). Photo Credit: Bruce Selyem
- Ponderosa Pine (*Pinus ponderosa*), Montana’s state tree, on the North Fork in Glacier National Park, Montana. Photo Credit: Dee Blank.
- Bluebunch Wheatgrass (*Agropyron spicatum*), Montana’s state grass. Photo Credit: Matt Lavin.
- Alpine Meadowrue (*Thalictrum alpinum*). Photo Credit: Matthew Stewart.

MONTANA NATIVE PLANT CONSERVATION STRATEGY
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7-1 Books, field guides, and apps developed using specimens from Montana's herbaria.
8-1 Lemhi Beardtongue and Large Pollen Wasp – a reciprocal connection.

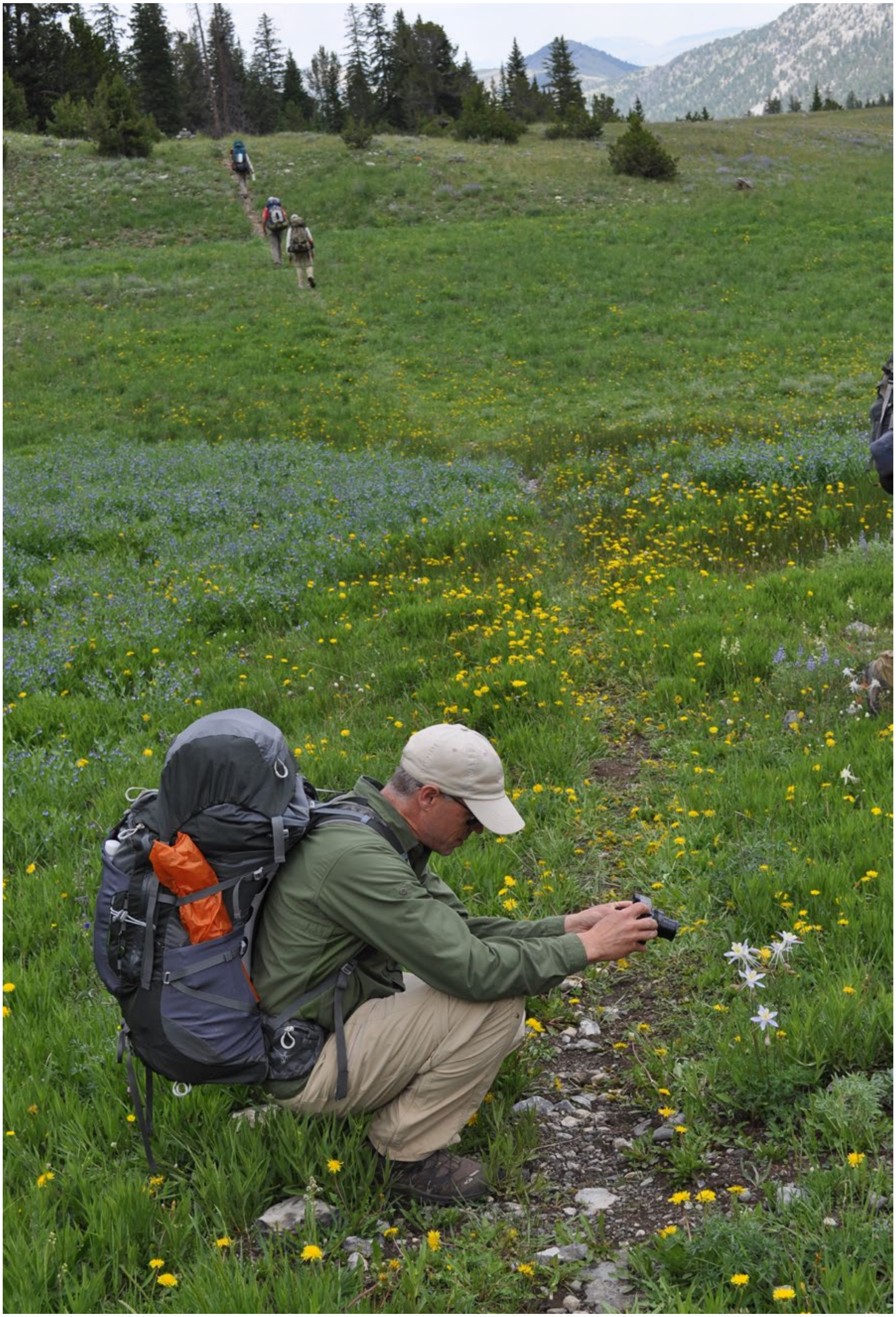

Photo Credit: Andrea Pipp

A group of botanists hike into the Italian Peaks in southwest Montana where they will conduct a plant inventory.

Executive Summary

EXECUTIVE SUMMARY

The *Montana Native Plant Conservation Strategy: Vascular Species and Habitats of Greatest Conservation Need*, hereafter *Strategy*, represents six years of collective input from a large partnership of people and organizations that share a vested interest in Montana's flora and habitats. The *Strategy* was written by a Core Team aided by a diverse partnership of people representing federal and state agencies, Tribal nations, non-governmental organizations, academic herbaria, and individuals. Its purpose is to promote the collective and coordinated stewardship of Montana's native flora and habitats, emphasizing native Plant Species, Unique Habitats, and Plant Communities of Greatest Conservation Need (GCN).

Montana is the fourth-largest state, with high biodiversity, large intact habitats, fragmented landscapes, many Tribal nations, an economy predominantly supported by agriculture, fossil fuel and timber industries, government, and tourism, and an increasing and sprawling human population. Under Montana's big sky, there is growing concern about how to retain our state's rich native plant diversity and genetics, rare species, unique habitats, and iconic plant communities. Despite the importance of native plants to all people, this statewide *Strategy* is sorely needed because of five constraints that have hampered plant conservation in Montana:

1) Insufficient current data and mapping of native plant populations, habitats, and communities, especially those of conservation concern
2) Declining recognition for botanical expertise and appreciation for plants
3) Limited funding allocated to native plant conservation
4) Inadequacy of policy-related and regulatory mechanisms to manage native plants and habitats
5) Increasing threats to native plants, habitats, and communities from natural events and human activities

The *Strategy* aims to provide a statewide framework that focuses on seven elements essential to the conservation of Plant Species, Unique Habitats, and Plant Communities of GCN, and other native plants. These seven elements are foundational to retaining an educated, informed, engaged, and coordinated botanical network across the state. Organized into sections each element of the *Strategy* explains its connection to the conservation of Plant Species, Unique Habitats, and Plant Communities of GCN and other native plants, shares developed resources, and outlines and identifies an array of conservation opportunities and actions to address the five constraints, listed above. Section 1 is the Introduction and below we summarize the seven elements and ask that readers refer to each section for the pertinent conservation objectives.

Why We Care about Native Plants!

- They are essential to Montana's biological diversity, functional ecosystems, cultural heritage, and economic sustainability.
- Humans and nearly all life rely on them for oxygen, food, medicine, shelter, wildlife habitat, and numerous products.
- They beautify Montana and the places where we live, work, and play.

Section 2:
Acknowledging Tribal Sovereignty and Some Native American Perspectives on Native Plant Conservation

Montana is – and has historically been – home to Native American peoples representing numerous Tribes, including eight federally recognized Tribal nations: Confederated Salish and Kootenai Tribes of the Flathead Reservation; Blackfeet Nation; Chippewa Cree Tribe of the Rocky Boy's Reservation; Fort Belknap Indian Community of the Fort Belknap Indian Reservation; Fort Peck Assiniboine and Sioux Tribes; Northern Cheyenne Tribe; Apsáalooke Nation on the Crow Reservation; and the Little Shell Tribe of Chippewa Indians. The Core Team acknowledges and honors Native American peoples, past and present, whose traditional homeland is the land that today we call the State of Montana.

The *Strategy,* and its authors, value the rights and sovereignty of all Tribal nations and Native American peoples across Montana. Section 2 covers basic information on Montana's federally recognized Tribal nations, shares some Native American perspectives on native plant conservation, and suggests some general approaches or actions to promote respectful dialogue and working relationships with Native American peoples. In addition, scattered through the conservation objectives in other sections are suggestions to remedy the long-standing exclusion of Native American peoples from organized conservation efforts. Throughout, the *Strategy* advocates for inclusivity of Native American peoples, their views, and their practices in efforts to sustain native plant species, habitats, and communities, especially for those of GCN.

Section 3:
Strengthening Botanical Capacity in Montana

Many native plant species, communities, and their ecological interactions are at risk. This also includes the many relationships between plant species and human communities and cultures. Botanical capacity is critical to conserving, maintaining, and managing the diversity of Montana's native flora, and the many important ways that plants sustain people, animals,

Photo credit: Dee Blank

Photo ES-1. As a keystone species Quaking Aspen (Populus tremuloides) *communities promote biodiversity, are culturally significant, and in many places are in need of regeneration. South Fork Teton Canyon, Montana.*

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[1] Global Strategy for Plant Conservation: https://www.cbd.int/gspc

and habitats. As a component in the *Global Strategy for Plant Conservation*[1], botanical capacity is defined as the human, scientific, technological, organizational, institutional, and resource capabilities that support plant-based education and training, basic and applied research, and environmental monitoring and management. In Montana, botanical capacity is embodied in our state's rich plant species diversity and in the accumulation of botanical knowledge that has come from Indigenous peoples, emigrants, and a long history of botanical exploration.

In Montana, botanical capacity has accumulated and expanded, but also fractured and eroded. Indigenous peoples have for thousands of years accumulated botanical knowledge on their ancestral lands. After the signing of treaties, many US laws, policies, and practices led to the loss of access and inherent rights to lands and plants, contributing to generational losses in traditional botanical knowledge. Despite these obstacles, a resurgence in traditional plant knowledge and practices is happening. For western culture, botanical exploration, growth of a public university system, and the establishment of land management agencies expanded and diversified botanical capacity. But during the last 30-40 years, significant reductions in the number of botany degrees and botanical coursework offered at academic institutions across the nation and in Montana have reduced botanical capacity. Periods of accumulation and expansion in botanical capacity have not occurred at the same time, nor equally for all parts of the population, effectively reducing botanical capacity and hindering plant conservation in Montana. This section, *Strengthening Botanical Capacity in Montana* addresses the sources of capacity, and the many ways people have gained and lost capacity at various periods in time; the need to embrace the components and complexity of capacity; and outlines goals and conservation objectives from four areas: information needs [inventory, monitoring, and research]; protection and restoration; outreach and education; and policy and regulation.

Strengthening botanical capacity requires invigorating educational systems; recognizing that good botanical skills are needed elements of other disciplines; developing botanical certifications where degrees are no longer possible; and introducing kids at any early age to the world of plants. It also means welcoming and respecting worldviews, perspectives, and traditional knowledge gained and used by Native American peoples; restoring, remediating, and reclaiming disturbed lands with sustainable methods using state- and local-sourced native plant species; and a whole lot more!

Section 4:
Montana's Vascular Plant Species of Greatest Conservation Need

Montana's native plants are an integral component of our biological diversity, functional ecosystems, cultural heritage, and economic sustainability. Furthermore, Montana's 431 rare and at-risk native plant species are a unique and irreplaceable part of the state's and nation's natural heritage. This Strategy identifies and prioritizes 109 Plant Species of GCN (Box ES-1). Section 4 relays general information on their status, distribution, and the activities and processes that can benefit or harm them. It outlines over-arching goals and conservation objectives from four areas: information needs [inventory, monitoring, and research]; protection and restoration; outreach and education; and policy and regulation.

The 109 Plant Species of GCN consist of 105 Montana Species of Concern (SOC) and 4 "management of concern" vascular plants. Most of these species are of GCN due to their rarity

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[1] Global Strategy for Plant Conservation: https://www.cbd.int/gspc

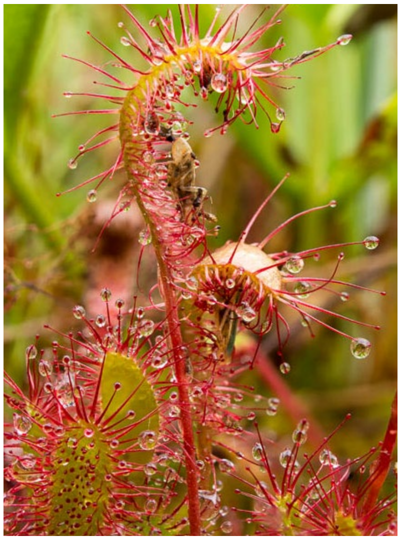
Photo credit: Dee Blank

Photo ES-2. An English Sundew (Drosera anglica) *plant traps a spider. Swan Valley, Montana.*

Photo credit: Bonnie Heidel

Photo ES-3. Northern Beechfern (Phegopteris connectilis) *is a rare find in northwest Montana.*

Photo credit: Dee Strickler

Photo ES-4. Payette Beardtongue (Penstemon payettensis) *is known from old observation records in southwest Montana.*

in Montana coupled with a direct or indirect threat as determined by the Montana State Threat Score. The 4 Plant Species of GCN that are of "management concern" are common and prominent on the landscape but observed by land managers from different agencies and/or Tribal nations as in potential decline from various threats. About 14 Plant Species of GCN are also classified as Plant Species of Greatest Inventory Need (PSGIN) because information on their populations, life history, or habitat conditions is poorly documented despite having mapped locations.

The 109 Plant Species of GCN are further divided into categories of priority. Priority 1 is assigned to 23 plant species for which there is more rigorous observation and mapping data and/or biological literature. Individualized conservation profiles with species-specific conservation objectives are developed for Priority 1 species. Conservation profiles for 5 GCN plant species have been completed and can be found in Appendix A: Sapphire Rockcress (*Boechera fecunda*), Water Howellia (*Howellia aquatilis*), Whitebark Pine (*Pinus albicaulis*), Spalding's Catchfly (*Silene spaldingii*), and Ute Ladies'-tresses (*Spiranthes diluvialis*). Future work on the Strategy is needed to complete conservation profiles for the remaining Priority 1 plants. Priority 2 is assigned to 86 plant species for which less is known beyond accurate observation data mapping. Available information, such as reports, monitoring plans, management guidelines, and identified needs for implementing conservation are to be relayed through spreadsheets and other formats shared by the partnership and posted on the developing Strategy's webpage, hosted by the Montana Natural Heritage Program (MTHHP).

Many Plant Species of GCN also have federal or Tribal designations. Of the 109 Plant Species of GCN, management responsibilities for 4 species are shared with the US Fish and Wildlife Service (USFWS) under the Endangered Species Act (ESA). Region 1 of the US Forest Service (USFS) designates 52 Plant Species of GCN as Sensitive or Species of Conservation Concern. The Montana/Dakotas Bureau of Land Management (MT/Dakotas BLM) designates 17 Plant Species of GCN as Sensitive. Some species also have Tribal designations and are protected by the specific Tribal nation through their own regulations, ordinances, and land management policies.

Box ES-1. 109 Plant Species of Greatest Conservation Need in Montana alphabetized by MTNHP's primary scientific name.

Agastache cusickii
Allium columbianum
Allium parvum
Alnus rubra
Ammannia robusta
Anthoxanthum hirtum
Astragalus barrii
Astragalus ceramicus var. *apus*
Astragalus ceramicus var. *filifolius*
Astragalus convallarius
Astragalus oreganus
Athysanus pusillus
Boechera fecunda
Braya humilis
Calochortus bruneaunis
Carex gravida
Carex idahoa
Carex sychnocephala
Castilleja covilleana
Cirsium longistylum
Clarkia rhomboidea
Cleome lutea
Cryptantha fendleri
Cyperus schweinitzii
Cypripedium fasciculatum
Cypripedium passerinum
Dichanthelium acuminatum
Dichanthelium oligosanthes var. *scribnerianum*
Draba densifolia
Drosera anglica
Drosera linearis
Eleocharis bella

Eleocharis rostellata
Elymus flavescens
Epipactis gigantea
Erigeron leiomerus
Erigeron linearis
Eriogonum salsuginosum
Eriogonum soliceps
Fraxinus pennsylvanica
Githopsis specularioides
Glossopetalon spinescens
Goodyera repens
Grayia spinosa
Grindelia howellii
Heterocodon rariflorum
Howellia aquatilis
Idahoa scapigera
Ipomopsis congesta ssp. *crebrifolia*
Kochia americana
Lagophylla ramosissima
Lemna valdiviana
Leptodactylon caespitosum
Lewisia columbiana
Lilium columbianum
Liparis loeselii
Lobelia kalmii
Lomatium nuttallii
Malacothrix torreyi
Mentzelia pumila
Mimulus breviflorus
Mimulus nanus
Mimulus primuloides
Muhlenbergia andina
Nama densum

Nuttallanthus texanus
Oenothera pallida ssp. *pallida*
Ophioglossum pusillum
Oxytropis campestris var. *columbiana*
Pedicularis crenulata
Penstemon angustifolius
Penstemon lemhiensis
Penstemon payettensis
Petasites frigidus var. *frigidus*
Phegopteris connectilis
Phlox missoulensis
Physaria carinata
Physaria didymocarpa var. *lanata*
Physaria douglasii
Physaria humilis
Physaria klausii
Physaria lesicii
Physaria pachyphylla
Pinus albicaulis
Pinus monticola
Pleiacanthus spinosus
Populus tremuloides[1]
Primula alcalina
Primula incana
Prunus pumila
Quercus macrocarpa
Ranunculus orthorhynchus
Rotala ramosior
Sandbergia perplexa
Scheuchzeria palustris
Sidalcea oregana
Silene spaldingii
Spiranthes diluvialis
Tetradymia spinosa
Thalictrum alpinum
Tonestus aberrans
Trichophorum alpinum

Trichophorum cespitosum
Trifolium eriocephalum
Trifolium gymnocarpon
Trifolium microcephalum

Utricularia intermedia
Vaccinium myrtilloides
Viburnum lentago

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[1] The *Strategy* treats *Populus tremuloides* as a GCN at the plant community level.

The 109 Plant Species of GCN are found at numerous locations (or occurrences) in Montana (Figure ES-1). Collectively, occurrences can be found in each of Montana's eight Level-1 Ecological System biological communities or land-use types. Collectively, occurrences are also found in all major landownership categories. Nearly 70% of GCN plant species have at least one occurrence on privately owned lands. Consequently, private landowners play an important role in conserving our state's rare species and native flora. Almost all of the GCN plant species have at least one occurrence on federal lands while 40% of GCN species have at least one occurrence on state lands. Tribal lands support at least one occurrence for 20% of the GCN plant species.

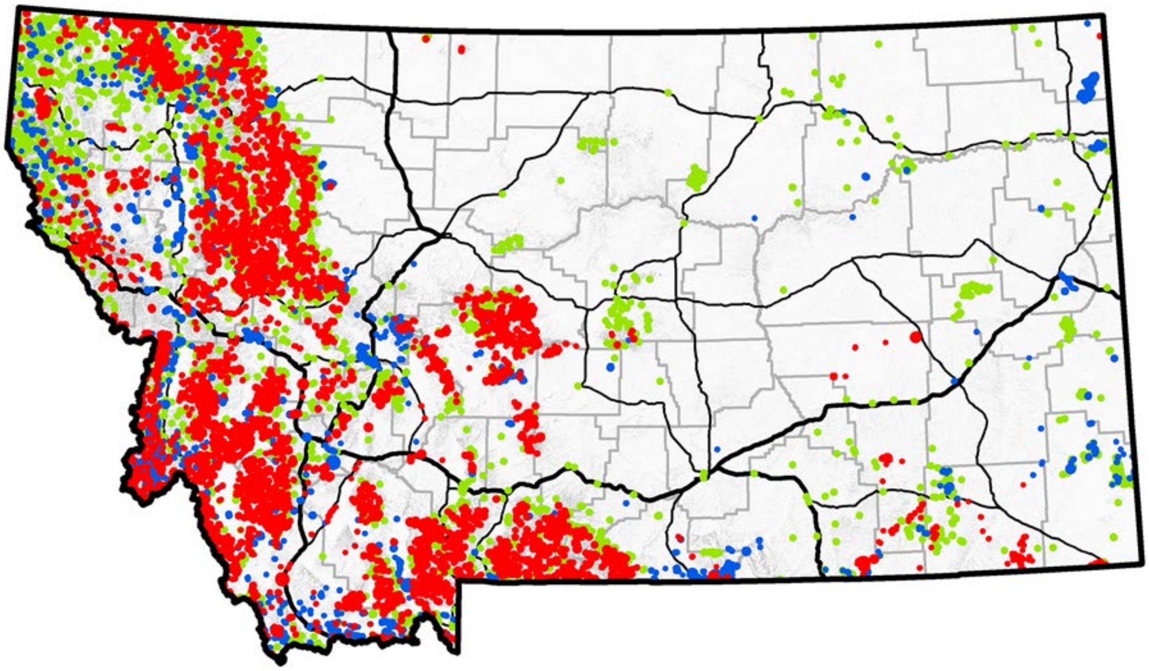

Figure ES-1. The distribution of Plant Species of GCN in Montana. Priority 1 SOC plants are in red. Priority 2 SOC plants are in blue. Priority 1 and 2 plant species of management concern are in green.

Most of the 109 Plant Species of GCN are vulnerable to loss from direct or indirect, documented or highly likely threats to their populations or habitat. The MTNHP tracks reported threats to Montana SOC and Potential Species of Concern (PSOC) plants in a database and periodically evaluates the data to assign a State Threat Score. Many factors, such as the species' biology, resiliency of the habitat, and the type, severity, and timing of the activity or process, determine whether that activity or process is or is not a threat to the plant. This section describes the most common types of natural or human activities in Montana that can hinder or benefit Plant Species of GCN and their habitats: altered hydrological regimes; invasive species and noxious weeds; mining; recreational activities (tourism, plant collecting, and motorized vehicles); residential, commercial, and transportation development; agricultural development; altered disturbance regimes (grazing, browsing, fire, and flooding); and climate change.

Conserving Plant Species of GCN requires actions to integrate them into the 2025 Montana State Wildlife Action Plan revision; garner funding; study or monitor species responses to activities and potential threats; develop incentives to preserve species and restore degraded habitats; make local native plant materials accessible to the public; develop a statewide score card to measure conservation efforts; use Important Plant Areas and the Montana Natural Area System to protect exceptional occurrences and habitat; acknowledge and support traditional protocols for handling native plant materials; and much more! Implementing suggested conservation objectives strengthens botanical capacity in Montana.

Section 5:
Unique Habitats of Greatest Conservation Need

Photo credit: Andrea Pipp

Photo ES-5. Wooded Vernal Pools are a Unique Habitat found in the Swan Valley, Montana. These pools promote biodiversity and can provide habitat for Water Howellia (Howellia aquatilis)*, a Plant Species of GCN.*

In various locations throughout Montana there are unique habitats that occupy relatively small areas, have formed under unusual combinations of geology, soil chemistry, hydrology, and/or other factors, and support rare plants and uncommon plant assemblages. Unique habitats are priorities for conservation because they support rare elements (species and/or plant assemblages), along with unique physical components (uncommon combinations of geology, soils, hydrology, or other ecological characteristics); and, typically are not included in plant community classifications such as the US National Vegetation Classification.

This *Strategy* identifies and prioritizes nine Unique Habitats of GCN (Box ES-2). Section 5 relays information on their general location, associated rare species, and outlines over-arching goals and conservation objectives from four aspects areas: information needs [inventory, monitoring, and research]; protection and restoration; outreach and education; and policy and regulation. Individualized conservation profiles with habitat-specific conservation objectives are to be developed for each unique habitat. Conservation profiles for two GCN unique habitats have been completed and can be found in Appendix B: Centennial Valley Sand Dunes and Metamorphosed Limestone. Future work on the Strategy is needed to complete conservation profiles for the remaining Unique Habitats of GCN. Information and conservations profiles are to be relayed and shared by the partnership and posted on the Strategy's web page, hosted by MTNHP.

Box ES-2. The Nine Unique Habitats of Greatest Conservation Need in Montana.

- Bedrock Glades
  - Granitic Glades
  - Argillite Bedrock Meadows
- Bentonite Deposits
- Centennial Valley Sand Dunes
- Metamorphosed Limestone
- Obsidian Sands
- Peatlands [Fens]
- Shale Barrens
- Vernally Moist Ledges
- Wooded Vernal Pools

Conserving Unique Habitats of GCN requires centralizing information; initiating field inventories to characterize, map, and assess sites; studying or monitoring ecological responses to activities and potential threats; evaluating the protective status of known locations; developing educational materials; establishing working groups to complete conservations profiles; and a whole lot more! Implementing suggested conservation objectives strengthens botanical capacity.

Section 6:
Plant Communities of Greatest Conservation Need

Photo credit: Dee Blank

Photo ES-6. Sagebrush plant communities at Hell Creek on the Charles M. Russell National Wildlife Refuge, Montana.

Numerous widespread plant communities characterize the terrestrial, riparian, and aquatic systems within the Rocky Mountain and Great Plains regions of Montana. Many national, regional, and state level classification systems have been used in Montana to describe, classify, categorize, and/or map our state's vegetation. Montana's Tribes also have ways of knowing the plant communities on their ancestral lands and the reservation lands they manage. Although widespread plant communities are prominent in Montana, some are of concern to land managers across the state because of natural or anthropogenic stressors from threats or a lack of protection or regulation. Tribal members have also expressed great concern for some of their important cultural plants and physical places because of natural or anthropogenic stressors and/or lack of protection or regulation.

The *Strategy* identifies and prioritizes five Plant Communities of GCN (Box ES-3). Section 6 relays information on their general location and outlines over-arching goals and conservation objectives from four areas: information needs [inventory, monitoring, and research]; protection and restoration; outreach and education; and policy and regulation. Individualized conservation profiles with plant community-specific conservation objectives are to be developed for each Plant Community of GCN. A conservation profile for one GCN plant community has been completed and can be found in Appendix C: Quaking Aspen (Populus tremuloides) Communities. Future work on the Strategy is needed to refine the remaining Plant Communities of GCN and develop conservation profiles. Information and conservation profiles are to be relayed and shared by the partnership and posted on the Strategy's web page, hosted by MTNHP.

Box ES-3. The Five Plant Communities of Greatest Conservation Need in Montana.

- Cottonwood Riparian Forest Communities
- Prairie Pothole Communities
- Sagebrush Communities
- Quaking Aspen Plant Communities
- Western (Montane) Grasslands

Conserving Plant Communities of GCN requires centralizing information; networking to establish working groups that could refine and develop community-specific conservation profiles; continuing to update vegetation mapping and classification; studying or monitoring ecological responses to activities and potential threats; evaluating the protective status of these communities across the state; joining existing partnerships to further management and conservation efforts; and many others! Implementing suggested conservation objectives strengthens botanical capacity in Montana.

Section 7:
The Roles of Herbaria in Plant Conservation

An herbarium preserves dried, pressed plant specimens that document Montana's flora, and that of our nation. With more than 200 years of plant collecting, Montana's herbaria document most of our state's botanical biodiversity and support the work of researchers, educators, land managers, conservation practitioners, consultants, and students. The preserved physical specimens and their associated labels with detailed information provide a foundation for classifying and communicating the names of plants, fungi, and algae found in natural areas, and those that are cultivated for agriculture, horticulture, and forestry. Additionally, herbarium specimens help us determine a species' distribution; evaluate environmental variables and threats that affect plant distributions; and assess the risk of extirpation or extinction for a given species. Herbaria are valuable tools for validating rarity, assessing population trends, and determining agency designations.

PLANTS OF MONTANA
Pine Butte Swamp Preserve Teton Co.
HERBARIUM
119829
UNIVERSITY OF MONTANA
Collected by Peter Lesica

Photo credit: University of Montana (MONTU) Herbarium

Photo ES-7. An herbarium specimen of Arrowleaf Balsamroot (Balsamorhiza sagittata) *- a forb iconic to Montana.*

Herbarium curators and collection managers are leading innovative processes to digitize plant specimen data while maintaining the preservation of physical specimens. Digitized plant specimens and their labels of information are free and publicly available through online portals. This has increased the use of plant specimen data, broadened the types of data users, and resulted in new applications for using specimens. Meanwhile, herbarium staff work to maintain the physical specimen, which makes it available for teaching, and for studies involving genetics, morphology, and taxonomy.

Despite the myriad of services and information provided by herbaria, collection managers and curators face multiple challenges to fund, operate, and maintain herbaria and their useful and irreplaceable plant specimens. Shifting academic priorities have created more competition for space and budgets, changed the nature of faculty hires, and decreased the number of formal botany degrees offered at universities and colleges - in Montana and nationally. However, the need continues to grow for plant-based skills in identification, management, restoration, and research. While visits to herbaria may be declining, online access to herbaria has significantly increased. Users of the on-line data often give credit to the portal that displays the data, but not the actual herbarium where specimens are stored, managed, imaged, and databased.

Section 7 identifies and prioritizes eight herbaria in Montana, and outlines a statewide strategic goal, five objectives, and many subsequent actions to help sustain them. The eight herbaria are registered on the Index Herbariorum and are located at: Montana State University (MONT), Montana State University-Billings (MSUB), University of Montana (MONTU), Glacier National Park (GLAC), Yellowstone National Park (YELLO), Beaverhead-Deerlodge National Forest (BDNF), Bitterroot National Forest (BNFH), and Tu-Hi Hong and Pum-Hi Hong Herbarium [GFC]. Information specific to each herbarium is provided in Appendix D.

Sustaining Montana's herbaria requires strengthening working relationships between the herbarium, university decision-makers, land management agencies, non-governmental organizations, consultants, and community support groups; identifying long-term funding sources and operational needs; retaining relevant and accessible specimen collections; serving the educational community; and a whole lot more!

Section 8:

The Importance of Native Plants and Communities in Sustaining Animal Pollinators

Native plants and pollinators co-evolved more than 65 million years ago. Today, animals help pollinate nearly 88% of the world's 352,000 flowering plant species. This symbiotic relationship has shaped the diversity of both plants and animals in our region and across the globe. The coexistence of native plants and native animal pollinators hinges on the ability of these species to live in functioning plant habitats. Such plant habitats can be found in one's backyard garden, in the wildest of places, and everywhere in between.

Native plants differ in their size, shape, habit, soil, water and nutrient requirements, and leaf chemistry, which means that where there is a diversity of plant species, there will be greater opportunities for animals to obtain their energy (food) with less competition. A greater array of native plant species also means more opportunities for native animal pollinators to find shelter, nesting, and resting sites, whether daily or seasonally, along with water, prey, and other components to carry out their life cycles.

Section 8 touches on the important services Montana's native plants and plant communities provide to pollinators, the need to sustain and use them in landscaping and restoration, and the effect pollinators have on rare and common native plants. Further, it highlights existing resources, relevant to Montana, that private landowners and public land managers can use to promote native plants, create communities, and in turn support animal pollinators. With a little research and effort, native plant communities can be created and maintained in small places. This section provides links to useful resources to determine and find native plant species and plant materials, along with tools to help create native plant pollinator habitat.

Photo credit: Aaron Clausen

Photo ES-8. Sulphur butterfly (family Pieridae*) foraging on a Dotted Blazing Star (*Liatris punctata*) plant near Great Falls, Montana.*

THE FUTURE FOR PLANT CONSERVATION IN MONTANA

Fortunately, there are still meaningful opportunities to make a difference for native plant conservation right now - in Montana. Compared to animals, Plant Species of GCN are relatively easy to conserve because they typically occur in small numbers and/or occupy discrete geographical areas. Thus, many Plant Species of GCN can often be protected with a relatively small investment of time and resources through voluntary and cooperative actions. Conserving Unique Habitats and Plant Communities of GCN can be compatible with other habitat-based projects and planning efforts that are more typically accomplished by federal and state agencies, Tribal nations, and non-government conservation organizations.

The overall goals of the *Strategy*, and the partnership behind it, are to conserve Montana's native Plant Species, Unique Habitats, and Plant Communities of GCN and ameliorate the five constraints that have hindered plant conservation. Conserving species, unique habitats, and communities - of greatest conservation need - means that biodiversity of native species is promoted in protection and restoration efforts, populations are sustainably managed or conserved to retain genetic exchange, viability, and health, natural ecological processes are emulated, and threats are abated.

This *Strategy* is a voluntary call to action - highlighting the conservation steps that federal, state, and local agencies, Tribal nations, non-government conservation organizations, private groups, academic institutions, and individuals can take to help accomplish one or more of the many secondary goals and prioritized objectives in this document. The Core Team envisions this *Strategy* as a living document, maintained by a *Strategy* Stewards Committee - a seven-member group representing MNPS, MTNHP, USFS, MT/Dakotas BLM, Montana Department of Natural Resources and Conservation, Montana Fish, Wildlife & Parks, and Tribal nation(s). The Core Team envisions that any person in Montana's botanical network or associated with the *Strategy*'s larger partnership could participate in, lead, or complete a conservation objective for which they feel motivated and have the skills, time, ability, and/or resources to work on. Successful implementation and conservation of Montana's native Plants Species, Unique Habitats, and Plant Communities of GCN go hand-in-hand with strengthening botanical capacity across all peoples in the state to support the recommended conservation objectives and any similar efforts not mentioned in this *Strategy*.

"In some Native languages the term for plants translates to 'those who take care of us.'"

~Robin Wall Kimmerer, author of
Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge, and the Teachings of Plants (2013)

Happy Botanizing!

SECTION 1

Introduction

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SECTION 1
INTRODUCTION

Purpose

The purpose of the *Montana Native Plant Conservation Strategy: Vascular Species and Habitats of Greatest Conservation Need*, hereafter the *Strategy*, is to promote the collective and coordinated stewardship of Montana's native flora and habitats. The Strategy was developed by a partnership of people representing federal and state agencies, a Tribal nation, non-governmental organizations (NGOs), academic herbaria, and individuals, whose goal is to ensure the persistence of native plant species and habitats, particularly those vulnerable to loss.

Conserving, researching, and sustainably managing Montana's native plant diversity and resources requires an educated, informed, engaged, and coordinated botanical network across the state. The *Strategy* outlines and prioritizes native plant species, unique habitats, and plant communities that are in greatest need of conservation, and identifies conservation objectives in four areas that guide plant conservation[1]:

- Information Needs [Inventory, Monitoring, Research]
- Protection and Restoration
- Outreach and Education
- Policy and Regulation

Photo Credit: Dee Blank

Photo 1-1. Native grassland with Silver Sagebrush (Artemisia cana) *and Meadow Deathcamas* (Zigadenus venonosus) *at the Bitter Creek Wilderness Study Area in northeastern Montana.*

The *Strategy*, also includes four additional elements that intersect with the conservation of species and habitats, specifically acknowledging Tribal sovereignty and Indigenous Traditional Ecological Knowledge (ITEK)[2]; strengthening botanical capacity across the state; investing in Montana's network of herbaria; and amplifying the role of native plants in pollinator conservation efforts. Collectively, this *Strategy* serves to share developed resources and guide future plant conservation actions using voluntary and non-regulatory mechanisms. The authors anticipate that voluntary implementation of identified conservation objectives will greatly help sustain Montana's native flora, vulnerable species, unique habitats, and plant communities, and strengthen botanical resources for stewardship on public and private lands.

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[1] This Strategy uses the term "conservation" as defined by the International Union for Conservation of Nature (IUCN) (Given 1994): "The management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations, while maintaining its potential to meet the needs and aspirations of future generations. Thus, conservation is positive, embracing preservation, maintenance, sustainable utilization, restoration, and enhancement of the natural environment (IUCN 1980)."

[2] Memorandum on Indigenous Traditional Ecological Knowledge and Federal Decision Making (Lander and Mallory 2021): "Traditional Ecological Knowledge - a form of Indigenous Knowledge - and one of many important bodies of knowledge that contributes to the scientific, technical, social, and economic advancements of the US to our collective understanding of the natural world. ITEK is a body of observations, oral and written knowledge, practices, and beliefs that promote environmental sustainability and the responsible stewardship of natural resources through relationships between human and environmental systems. It is applied to phenomena across biological, physical, cultural, and spiritual systems. ITEK is owned by Indigenous people."

Scope

The *Strategy* focuses on seven elements pertinent to native plant conservation in Montana and foundational to the state's botanical network (Box 1-1). Hence, the *Strategy* is an electronic document consisting of interrelated, mostly stand-alone sections, posted on the *Montana Native Plant Strategy* web page hosted by the Montana Natural

Box 1-1. *Montana Native Plant Conservation Strategy: Vascular Species and Habitats of Greatest Conservation Need* (GCN) – AT A GLANCE.

Section 1: Introduction to the *Strategy*
Outlines purpose, scope, components, audience, importance of plants, and needs for a statewide Strategy.

Section 2: Acknowledgement and Native American Perspectives on Native Plant Conservation
Recognizes Tribal sovereignty; relays information on Tribes in Montana; presents some Native American peoples' perspectives on native plant conservation; and suggests actions to improve working relationships with Tribes and Native American peoples.

Section 3: Strengthening Botanical Capacity
Defines botanical capacity, where it comes from, what has been gained, sources eroding it, and conservation goals and objectives to strengthen capacity.

Section 4: Vascular Plant Species of GCN
Addresses Montana's flora; species' rarity, status, distribution, & risk factors; identifies 109 Plant Species of GCN and outlines overarching species conservation objectives for information needs, protection and restoration, outreach and education, and policy and regulation.

Appendix A: *Species-specific conservation profiles for 5 Plant Species of GCN*[1].

Section 5: Unique Habitats of GCN
Defines and identifies 9 Unique Habitats of GCN; outlines overarching habitat conservation objectives for information needs, protection and restoration, outreach and education, and policy and regulation.

Appendix B: *Habitat-specific conservation profiles for 2 Unique Habitats of GCN*[1].

Section 6: Plant Communities of GCN
Defines and identifies 5 Plant Communities of GCN; outlines overarching plant community conservation objectives for information needs, protection and restoration, outreach and education, and policy and regulation.

Appendix C: *Plant community-specific conservation profile for 1 Plant Community of GCN*[1].

Section 7: Roles of Herbaria in Plant Conservation
Addresses Montana's herbaria, their purpose, establishment, and significant contribution to the conservation of plants, fungi, and algae. Identifies 7 challenges facing Montana's herbaria and outlines proactive actions to help ensure their continued use and service to plant conservation.

Appendix D: *Herbarium-specific profiles for 8 herbaria.*

Section 8: Importance of Native Plants and Communities in Sustaining Animal Pollinators
Discusses the reciprocal relationship among native plant species, plant communities, and native animal pollinators. Encourages landowners to create native plant pollinator habitats and links readers to resources pertinent to Montana on what and how to grow native plants and communities.

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[1] Conservation profiles for the remaining Plant Species, Unique Habitats, and Plant Communities of GCN will be developed upon collaboration, initiation, and funding by members of the partnership.

Heritage Program[3]. Moving forward, this *Strategy* is meant to be a living document - updated or expanded by the botanical network in Montana (Box 1-2).

This *Strategy* identifies and prioritizes 109 vascular plant species, 9 unique habitats, and 5 plant communities determined to be in greatest need of conservation in Montana. They are referred to in this *Strategy* as Plant Species of Greatest Conservation Need (GCN), Unique Habitats of GCN, and Plant Communities of GCN. They are determined to be of GCN by members of the partnership because either

Box 1-2. What is meant by a "living document"?

The authors' intention is to make the *Montana Native Plant Conservation Strategy* - a living document - managed either on a website or webpage that can be completed, revised, and expanded by an educated, informed, engaged, and coordinated botanical network led by a Strategy Stewards Committee.

We envision the Strategy Stewards Committee to provide strategic direction that promotes implementing the goals, conservation objectives and actions, and products identified in the *Strategy*. This includes providing central coordination; general management of working groups; format and content review of products; and approval of products or links to post on the webpage. We envision the Strategy Stewards as composed of at least seven members designated or represented by:

- MNPS - Conservation Committee member;
- MTNHP - botanist and ecologist;
- USFS Region 1 - Regional botanist;
- MT/Dakotas BLM - State botanist;
- MFWP - plant ecologist;
- MTDNRC - forest ecologist; and
- Tribal nation - ethno-botanist.

Vascular Species and Habitats of Greatest Conservation Need represents Part 1, which is also a work in progress. We envision that any person, in Montana's botanical network or associated with the *Strategy*'s larger partnership, could initiate to complete, lead, or participate in implementing a conservation objective for which they feel motivated and possess the skills, time, ability, and/or resources to work on.

Future developments of Part I include:

- Completing Part 1 by organizing appropriate working groups to write conservation profiles specific to any of the remaining Plant Species, Unique Habitats, or Plant Communities of GCN.
- Implementing any of the conservation objectives identified in Part 1 of the *Strategy*.
- Developing a tracking system or ways that actions and accomplishments of the *Strategy* could be reported.
- Reviewing and revising the 2024 list of Plant Species, Unique Habitats, and Plant Communities of GCN; conservation profiles in Appendices A, B, and C; or conservation objectives presented in Part 1 of the *Strategy*.

Future parts of the *Strategy* would involve the development of new components, such as for non-vascular taxa (e.g., mosses, lichens, fungi) and the addition of a new element (e.g., plant genetics; plant education strategy) not previously addressed in the conservation of plants, fungi, and algae[1].

We envision the Montana Native Plant Conservation Conference, which is sponsored by the Montana Native Plant Society and meets biennially, as a possible venue for the Strategy Stewards to convene, engage with the botanical network, and conduct business relative to the *Strategy*. We also envision that the Strategy Stewards could hold a summer retreat to meet, brainstorm, revise, or develop new plans. We recognize that the Strategy Stewards may want to meet more frequently or through other platforms.

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[1] Montana Native Plant Conservation Strategy, Part 1 defines plant to include vascular, moss, liverwort, and hornwort species; fungus to include lichenized and non-lichenized fungal species; and algae to include diatom, cyanobacterium, and brown and green alga species.

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[3] Montana Natural Heritage Program: https://mtnhp.mt.gov/

their rarity or prominence on the landscape coupled with known direct or indirect threats and other factors puts their long-term persistence into question (Montana Rare Plant Strategy Steering Committee 2019; Montana Native Plant Strategy 'Criteria, Species, and Habitat' Subcommittee 2021). This *Strategy* develops voluntary conservation objectives at two levels: 1) overarching conservation objectives that apply to most, if not all, Plant Species, Unique Habitats, and Plant Communities of GCN; and 2) species-, habitat-, and plant community-specific conservation objectives in stand-alone conservation profiles (Box 1-1).

Audience

The primary audience of this *Strategy* are all the members of the larger partnership, and also federal and state public land managers (e.g., biologists, botanists, and rangeland specialists), non-government conservation organizations (e.g., conservation practitioners, plant societies, bird societies), academia (e.g., researchers, professors, herbaria collection managers), decision-makers (e.g., USFS District Rangers, BLM Field Office Managers, university and college administrators, non-government organization (NGO) executive directors and managers), and Tribal nations (e.g., Elders, traditionalists, plant gatherers, biologists, cultural directors, and administrators). The secondary audience includes relevant federal, state, and local government officials (e.g., Montana Governor and General Assembly, USFS Region 1 Forester, USFWS Mountain Prairie Regional Director, BLM State Director, local elected officials), public school educators, private landowners, private landowner groups (e.g., grazing associations, land trusts, private timber companies), Tribal members, and other stakeholders. To these audiences, this *Strategy* serves as an explanation of the challenges and the solutions proposed by the partnership to conserve and advance stewardship of Montana's vascular plant species, unique habitats, and plant communities of GCN.

Photo Credit: Tara Luna

Photo 1-2. Common Camas (Camassia quamash)*, American Bistort (*Polygonum bistortoides*), and Field Chickweed* (Cerastium arvense) *along the Rocky Mountain Front in Glacier County, Montana.*

WHY NATIVE PLANTS MATTER

Native plants are an integral component of our Nation's biological diversity, functional ecosystems, cultural heritage, and economic sustainability (Neely et al. 2009). Nearly all life, including humankind, is sustained through the powerful process of photosynthesis, whereby plants take in water, sunlight, and carbon dioxide and produce oxygen and carbohydrates. This reciprocal exchange of carbon dioxide and oxygen between plants and animals fuels our living planet. Plants also fuel our economy and sustain our basic needs for food and shelter, as well as medicine and numerous products like rope and rubber. Most other animals, directly or indirectly, rely on plants to provide food, shelter, and habitats for resting and rearing young. It is the unique assemblages of native plants that characterize Montana's western forested mountains, Rocky Mountain Front, eastern rolling grasslands, high alpine elevations, low valley bottoms, and the arid, riparian, wetland, and aquatic habitats found throughout the state. These native plant species and habitats form the places where we live, work, and recreate.

Native plants and the ways they sustain us are indispensable (Tallamy 2009); however, our Nation is at risk of losing significant portions of our wild heritage and the ecological resilience that comes with plant diversity (Stein and Gravuer 2008). An estimated 34% of vascular plants are at-risk of extinction in the United States (US), including more than 33,000 species of trees, grasses, orchids, cacti, ferns, and forbs (NatureServe 2023). Approximately 41% of terrestrial and wetland ecosystems are at risk of range-wide collapse in the US due to extensive land-cover conversion (NatureServe 2023). Among the most threatened ecosystems are the temperate grasslands (NatureServe 2023), which makes up two-thirds of Montana's land base. While it may seem that few people are aware of or concerned about the fates of plants, the extensive decline of Whitebark Pine (*Pinus albicaulis*), decline of Sweetgrass (*Anthoxanthum hirtum*) in the Bear Paw Mountains, and elevated awareness of the danger posed to Green Ash (*Fraxinus pennsylvanica*) from the Emerald Ash Borer (*Agrilus planipennis*) remind us of the significant ecological, cultural, and economic benefits native plants provide (Photo 1-3).

> ***"In some Native languages***
> ***the term for plants translates to***
> ***'those who take care of us.'"***
>
> ~Robin Wall Kimmerer, author of
> *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge,and the Teachings of Plants (2020)*

> ***"We are related to all living***
> ***things which includes plants.***
> ***They are us and we are them."***
>
> ~Keith Gopher,
> Rocky Boy Tribe (2024)

> ***"Native Plants heal us,***
> ***provide Holistic well-being,***
> ***and are living beings.***
> ***We are part of the same life force,***
> ***and therefore, give respect by***
> ***praying and offering tobacco."***
>
> ~Dennis Longknife Jr,
> Fort Belknap Indian Community
> (2024)

Under Montana's big sky, there is a growing concern on how to retain our State's rich native plant diversity and genetics, rare species, unique habitats, and iconic plant communities. Despite the importance of native plants, conservationists, naturalists, educators, biologists, agricultural producers, Indigenous people, and others continue to face the tremendous challenge of encouraging humanity to understand, respect, and care for Montana's native plants and habitats. The pressures on our native plants and habitats call for a proactive, coordinated approach to help avoid further losses of species and prevent more federal listings of endangered and threatened plants. The human population of Earth reached 8 billion in late 2022 and is expected to exceed nearly 10 billion people by the year 2050 (United Nations 2024). Given all we know about human reliance on native plant life for sustenance, healthcare, and recreation, it will always be in our best interest as a species to understand and preserve their existence.

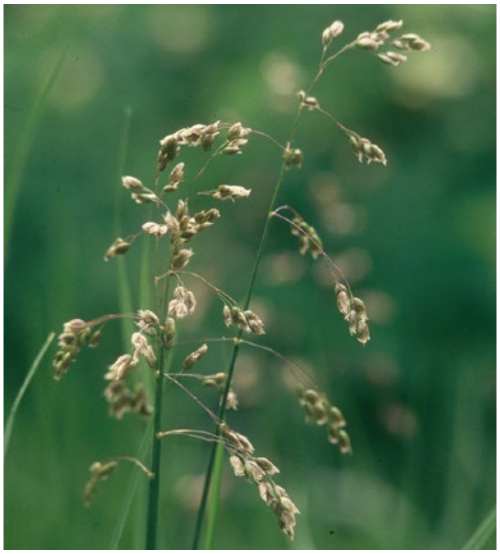
Photo Credit: Tara Luna

*Photo 1-3. Northern Sweetgrass (*Anthoxanthum hirtum*) is an aromatic grass of cultural significance that is exhibiting declines in some areas.*

NEED FOR A STATEWIDE NATIVE PLANT CONSERVATION STRATEGY

The need for a *Montana Native Plant Conservation Strategy* arises from five constraints that have hampered plant conservation efforts in the state:

1) Insufficient current data and mapping of native plant populations, habitats, and communities
2) Declining recognition for botanical expertise and appreciation for native plants
3) Limited funding allocated to native plant conservation
4) Inadequacy of regulatory mechanisms to manage native plants and habitats
5) Increasing threats to native plants, habitats, and communities

The *Strategy* aims to provide a statewide framework to address these needs and identifies an array of conservation opportunities and actions to reverse these constraints. Here we briefly discuss each need to better understand the problems and work toward solutions that reverse these five constraints:

1) *Insufficient Current Data and Mapping of Native Plant Populations, Habitats, and Communities*

The application of western science[4], advances in technology, and emphasis on inventorying species led to innovative ways in documenting, storing, sharing, and using information on Montana's flora. From the 1970s to early 2000s, many federal land management agencies focused on conducting rare plant inventories and defining, describing, and mapping habitat types and plant communities. This generated significant plant and habitat data, deposited plant specimens into agency and university herbaria, and contributed to the need for creating the Montana Natural Heritage Program (MTNHP). Since 1985, the MTNHP has served as a central repository for information on our state's flora, fauna, and biological communities. The development of a statewide plant observation database has facilitated processes to refine state plant checklists, map species distributions, determine a species' origin and rarity, and evaluate a species' status - all of which can be important to inform land use decisions. However, plant inventories generate data relevant to the time period. While the data remains relevant for tracking species and population trends, it becomes outdated for use in land management project and planning efforts. A large portion of Montana's plant-related data is now old, incomplete, and/or imprecisely mapped for Plant Species, Unique Habitats, and Plant Communities of GCN.

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[4] Western science is defined as the scientific enquiry done in Greek, Latin, or Arabic (Wallace 1992).

Today, Montana needs another period of extensive surveys, this time focused on revisiting existing rare plant occurrences and targeting unique habitats and plant communities. Current information is needed to evaluate specific population sizes, assess the presence of threats, quantify habitat characteristics, and precisely map species, habitat, and community locations. Comparing new information against older baseline conditions will help to determine or revise state ranks, state threat scores, Species of Concern lists, and population trends. Determining or revising state ranks and their status is necessary to inform agency listings, direct management actions, and ensure that management decisions are based on current and accurate information.

There is also a need to take into consideration cultural values when providing information for stewardship or conducting status assessments. Currently, there has been a failure to integrate western science methods with Indigenous Knowledge[5] and cultural values in many status assessments, information resources, and management plans. Improving government-to-government relationships between the State of Montana and the Tribes could facilitate the ability to integrate cultural values into these status assessments, information resources, and management plans, making plant-related data more comprehensive, and enhancing statewide conservation for particularly important species.

2) *Declining Recognition for Botanical Expertise and Appreciation for Plants*

Botanical knowledge and science education are essential to the application of "best" land management practices, sound conservation decision-making, and having an engaged, environmentally literate society (Havens et al. 2014). Declines in botanical degree programs, a shortage of government employed botanists, and an under-appreciation of plants continue to hinder plant conservation efforts (EMNRD-Forestry Division 2017; Balding and Williams 2016; Kramer et al. 2013; Deng 2015). From 1988 to 2015, shifting academic priorities caused at least 18 of the 50 top-funded universities in the United States to stop offering advanced degrees in botany (Deng 2015; Kramer et al. 2013). The Montana University System (MUS) has taken a similar path. Traditional degrees in botany have been retired or re-tooled into various flavors of biology, environmental studies, and other MUS degree programs. This *Strategy* takes no position and makes no judgement on the degrees offered by the MUS; it simply acknowledges the fact that today fewer plant identification, plant ecology, and other botanical courses

Photo Credit: Andrea Pipp

Photo 1-4. Botanical skills are needed in many disciplines, such as in restoring riparian habitat along the Clark Fork River in Montana.

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[5] Also, ITEK, TEK, and TK. Refer to footnote 2, Section 1 and to the glossary.

are offered in Montana. Fewer courses and trainings contribute to the phenomena of plant blindness, which is “the inability to see or notice the plants in one’s own environment” which often leads “to the inability to recognize the importance of plants in the biosphere and in human affairs” (Wandersee and Schussler 1999; Balding and Williams 2016).

Overlapping this academic trend is the consolidation of government botany positions into range, wildlife, and other natural resource job classifications (Kramer et al. 2013; Deng 2015). Management and research staff with botanical degrees are in short supply, and this is particularly pronounced in agencies responsible for stewarding our public lands (Kramer et al. 2013). In the federal government, workloads for botanists are often greater than those for wildlife biologists yet are matched with comparatively lower salaries (Kramer et al. 2013). Fortunately, in Montana there has been an upward trend since 2021 in the number of professional botanists hired by the USFS-Region 1 and Montana/Dakotas BLM (Pipp 2024). However, many professional positions in Montana combine botany with other disciplines.

For Indigenous peoples the decline of botanical knowledge is rooted in other causes. Legacies of colonialism, forced assimilation, upheaval and repression of Native economic systems, and loss of ancestral lands, languages, natural resources, and discrimination have contributed to a loss in botanical knowledge, including Traditional Knowledge, in Montana (Whyte et al. 2021). Tribes continue to address the effects of this historical trauma using their own systems of governance that have norms of behavior for land use and land care (Whyte et al. 2021). Traditional societies and key people within each Tribe have strived to pass on traditional plant knowledge to the next generation. During the past few decades, there has been a resurgence in traditional plant knowledge and practices, in part due to the recognition that this knowledge could potentially be lost by the rapid conversion to technology, from environmental changes, and most recently, from the pandemic. During the pandemic, the Tribal communities lost many elders; when a Tribal or Indigenous Elder passes, so does vast amounts of knowledge (Longknife 2024). The future of each Tribal nation rests solely in each Tribe’s successive generation and their individual ability to protect culturally significant plants and vegetation (Grant 2024).

Despite these challenges, there continues to be a great need for botanical expertise and a better societal appreciation for Montana’s native plants. Given the rise in new plant invaders, the continual spread of exotic plants, the increase in the number of imperiled native plants, and the large acreages of lost or degraded habitats that are in need of restoration or remediation, the evidence is clear that botanical expertise and traditional knowledge is imperative (Kramer et al. 2013).

3) Limited Funding Allocated to Native Plant Conservation

Plant conservation efforts are less funded than wildlife conservation at federal and state levels (Kramer et al. 2013; EMNRD-Forestry Division 2017). The Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. § 1531 et seq.) provides evidence. Of the 2,281 species listed as threatened or endangered, roughly 41% (944) are plants (Havens et al. 2014). Yet, plants often receive less than 4% of the funding allocated through ESA legislation (Havens et al. 2014). Region 6 of the USFWS, which includes Montana, allocates ESA-Section 6 funding for plants and animals across 8 states through a competitive grant process. The USFWS has occasionally tried to improve funding opportunities for plant conservation, as with the now-defunct Small Grants for

Plants. In 2000, Congress enacted the Wildlife Conservation and Restoration Program, whereby states with approved State Wildlife Action Plans (SWAP) receive significant amounts of federal funding to support non-game animal species (Stein and Gravuer 2008). These federal funds are managed by the USFWS through the State Wildlife Grants Program, which is the only federal program that has an explicit goal of preventing listings of animal species under the ESA (Stein and Gravuer 2008). Currently this funding cannot be used for the conservation of state rare or federally-listed threatened and endangered plants (USFWS 2010). Since 2021, attempts to correct this shortfall have been made in Congress with annual introductions of the bill, Recovering America's Wildlife Act (RAWA). Passage of RAWA would provide funding to states that include plants in their SWAP and to tribes to implement collaborative plant-focused and other wildlife conservation efforts (RAWA 2021; RAWA 2022).

At the State level, grants that fund plant-focused projects are few, and usually tied directly to wildlife, fisheries, or wetland habitats and invasive and noxious plant projects. The 2015 Montana SWAP (Montana's SWAP 2015) does not include Plant Species of GCN, which means there is no funding mechanism to address state-designated Species of Concern (SOC) or Potential Species of Concern (PSOC) plants or lichens (Box 1-3). However, future funding opportunities could become available for Plant Species of GCN in Montana. Montana Fish, Wildlife, and Parks is slated to add the list of Plant Species of GCN to the 2025 revision of Montana's SWAP (Szcodronski 2023). If coupled with approved congressional funding through RAWA, cooperating partners with MFWP and Tribal nations would have funding opportunities to carry out plant and wildlife conservation projects and education (S.2372 RAWA of 2022). Investing directly in the conservation of Plant Species of GCN using state and federal funding mechanisms is the most cost-effective way to aid their persistence (Stein and Gravuer 2008). Furthering the persistence of Plant Species, Unique Habitats, and Plant Communities of GCN contributes to the protection and improvement under Article IX Environment and Natural Resources in The Constitution of the State of Montana (Mont. Const. of 1972, art. IX).

Box 1-3. State of Montana designations for native vascular plants, mosses, and lichens.

Species of Concern (SOC)

Native taxa that are at risk of extirpation due to declining population trends, threats to their habitats, a restricted distribution, and/or other factors. Montana has 369 vascular plant, 50 moss, and 32 lichen SOC (MTNHP 2024).

Potential Species of Concern (PSOC)

Native taxa for which current, often limited, information suggests a potential for vulnerability to extirpation in the state. Montana has 63 vascular plant, 18 moss, and 8 lichen PSOC (MTNHP 2024).

Plant Species of Greatest Conservation Need (GCN)

A vascular plant designated either as SOC or 'of management concern' that is well-documented in the state and faces significant direct or indirect threats to its persistence or its habitat. Some plants are also in need of inventory. The 109 Vascular Plant Species of GCN were identified by the Montana Native Plant Strategy 'Criteria, Species, and Habitat' Subcommittee (2021).

4) *Inadequacy of Regulatory Mechanisms to Manage Native Plants and Habitats*

The inadequacy of regulatory mechanisms and laws to protect ESA-listed threatened and endangered plants and State of Montana SOC and PSOC (including Plant Species of GCN), and Unique Habitats and Plant Communities of GCN, is a major concern hampering the conservation of Montana's native flora. Federal laws have the strongest level of protection, but only apply to ESA-threatened plant species on federal lands or to federally-funded projects or to ESA-endangered plants on federal, state, and private lands; to Regional Forester Sensitive Species (USDA 2023) and Species of Conservation Concern (USDA 2019, 2020a, and 2020b) designated by the USFS-Region 1; and to Sensitive species designated by the Montana/Dakotas Bureau of Land Management (MT/Dakotas BLM 2008). Designated USFS-Region 1 and MT/Dakotas BLM species are managed in accordance with agency-specific policies that vary greatly by national forest or field office and apply only to the lands they administer. While these federal regulations and policies are beneficial and must be fully supported, they also fall short of actively conserving most Plant Species of GCN, SOC, or PSOC.

Patterned after NEPA and enacted in 1971, the Montana Environmental Policy Act (MEPA) is a procedural process intended to provide for adequate review of state actions that affect the quality of the human environment[6] (Stockwell 2021). Each state agency (with few exceptions) adopts the MEPA model rules (aka administrative rules) through its own individual rulemaking procedures; therefore, state agencies differ in their policies and rulemaking abilities to address, conduct environmental reviews, and/or manage Montana SOC and PSOC plants (Stockwell 2021). The MTNHP was established under the Montana State Library "to be a comprehensive program for the acquisition, storage, and retrieval of existing data relating to the natural resources of Montana" (MCA 90-15-301). Federal, state, and local government agencies, private consulting firms, NGOs, and others acquire data on native and exotic plants, biological communities, and animals from the MTNHP databases for their proposed projects and planning efforts. Because very few state laws or policies specifically address or protect rare plants, conservation of these species is mostly left to the individual land management agency and landowner.

Privately owned lands make up nearly 63% of Montana's land base, and their management is important to the conservation of Montana's rare plants. With very few exceptions, federal and state laws do not govern rare plants on private lands. A plant protection program supported by state government with broad involvement by stakeholders at all levels is needed to ensure the long-term conservation and stewardship of Montana's Plant Species, Unique Habitats, and Plant Communities of GCN.

Photo Credit: Grahm Johnson

*Photo 1-5. Missoula Phlox (*Phlox missouliensis*) is only known from Missoula County, Montana where its habitat intersects with city parks and utility corridors.*

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[6] 'Human environment' includes but is not limited to biological, physical, social, economic, cultural, and aesthetic factors that interrelate to form the environment" (Stockwell 2021).

5) *Increasing Threats to Native Plants*

Montana's Plant Species of GCN, and other rare plant species, are rooted in place and cannot avoid impending threats that interrupt their growth or life cycle. They often inhabit specific habitat types, geology, or soils, are found in few places, or are few in number.

Many of Montana's rare plants are facing increasing threats from multiple vectors (MTNHP Threat Assessment 2021). They can be negatively impacted by naturally occurring events, human actions, or an accumulation of natural factors exacerbated by human actions (Box 1-4). How a rare plant species responds to a particular threat - depends upon its biology, population size, reproductive rate, factors of stress or resiliency in the habitat, and other environmental conditions. The timing and severity of a threat event or action also greatly influences a native plant species' response. Types of threats that commonly occur in Montana and can harm native plant species, depending upon the species and local conditions include, but are not limited to:

- climate change
- invasive non-native (exotic) plant or animal species
- altered hydrological regimes
- altered fire regimes
- changes in land use or habitat conversion
- excessive ungulate herbivory (ecologically incompatible grazing)
- lack of ecological disturbances, such as lack of fire, cultural burning, flooding, grazing, browsing, or others

For a better understanding of threat types and the factors that can benefit or harm Plant Species of GCN, please read Section 4-Plant Species of GCN, subsection *Challenges Faced by Plant Species of Greatest Conservation Need.*

Box 1-4. What is a threat?

Threat: The proximate activity or process that has caused, is causing, or may cause destruction, degradation, and/or impairment to the target plant.

Threats may be related to human activities or may be natural.

~ Master et al. 2012
NatureServe Conservation Status
Assessments: Factors for Evaluating
Species and Ecosystem Risk

REFERENCES

Balding, Mung, and Kathryn J. H. Williams.. 2016. "Plant blindness and the implications for plant conservation." *Conservation Biology* 30(6): 1192-99. https://conbio.onlinelibrary.wiley.com/doi/10.1111/cobi.12738

Deng, Boer. 2015. "Plant collections get pruned back: North America's herbaria wilt under budget pressure." *Nature* (523) 16. https://doi.org/10.1038/523016a

EMNRD-Forestry Division. 2017. New Mexico Rare Plant Conservation Strategy. Prepared and developed by Daniela Roth and the New Mexico Rare Plant Conservation Strategy Partnership. Santa Fe, NM.

Gopher, Keith. 2024. Personal Communication. Water Quality Manager and Former Wetlands Manager, Water Resources Office, Chippewa-Cree of the Rocky Boy Tribe, Box Elder, MT.

Grant, Emerald. 2024. Personal Communication. Wetlands Manager, Blackfeet Environmental Office, Blackfeet Nation, Browning, MT.

Given, David R. 1994. *Principles and Practice of Plant Conservation*. Portland, OR: Timber Press 292 pp.

Havens, Kayri, Andrea T. Kramer, and Edward O. Guerrant, Jr.2014. "Getting plant conservation right (or not): the case of the United States." *Int. J. Plant Sci*. 175(1): 3-10. https://www.journals.uchicago.edu/doi/full/10.1086/674103

Kimmerer, Robin Wall. 2013. *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge, and the Teachings of Plants*. Milkweed Editions. 408 pp.

Kramer, Andrea T., Barbara Zorn-Arnold, and Kayri Havens. 2013. "Applying lessons from the U.S. Botanical Capacity Assessment Project to achieve 2020 Global Strategy for Plant Conservation targets." *Annals of the Missouri Botanical Garden*. 99(2): 172-79.

Lander, Eric, and Brenda Mallory. 2021. Memorandum on Indigenous Traditional Ecological Knowledge and Federal Decision Making. November 15th. Executive Office of the President, Office of Science and Technology Policy, Council on Environmental Quality, Washington, D.C.

Longknife, Dennis. 2024. Personal Communication. Climate Change Coordinator, Fort Belknap Indian Community, Harlem, MT.

Master, L. L., Don Faber-Langendoen, R. Bittman, G. A. Hammerson, B. Heidel, L. Ramsay, K. Snow, A. Teucher, and A. Tomaino. 2012. NatureServe Conservation Status Assessments: Factors for Evaluating Species and Ecosystem Risk. NatureServe, Arlington, VA.

Montana. 1972. Constitutional Convention (1971-1972), Article IX. Montana Constitutional Convention Proceedings, 1971-2=1972, Volume 7. https://courts.mt.gov/external/library/docs/72constit.pdf

Montana Native Plant Strategy 'Criteria, Species, and Habitat Subcommittee'. 2021. Recordings and - notes from - meetings held -February 3 - March 31. - Led by Andrea Pipp, Botanist, Montana Natural Heritage Program, Helena, MT.

Montana Natural Heritage Program (MTNHP) Threat Assessment. 2021. State Threat Score Assignment and Assessment of Reported Threats from 2006 to 2021 for State-listed Vascular Plants. Botany Program, Montana Natural Heritage Program, Helena, Montana.

Montana Rare Plant Strategy Steering Committee. 2019. Montana Rare Plant Conservation Strategy Kick-off Meeting notes. Meeting April 26, 2019; - notes prepared - June 6, 2019 and available from Andrea Pipp, Botanist, MTNHP, Helena, MT.

Montana's State Wildlife Action Plan (Montana's SWAP). 2015. Montana Fish, Wildlife & Parks, 1420 East Sixth Avenue, Helena, MT 59620. 441 pp.

National Environmental Policy Act of 1969. 1970. January 1 (42 U.S.C. §§ 4321 et seq.)

NatureServe. 2023. Biodiversity in Focus: United States Edition. NatureServe, Arlington, VA. https://www.natureserve.org/bif [Accessed 2 January 2024]

Neely, B., S. Panjabi, E. Lane, P. Lewis, C. Dawson, A. Kratz, B. Kurzel, T. Hogan, J. Handwerk, S. Krishnan, J. Neale, and N. Ripley. 2009. Colorado Rare Plant Conservation Strategy. Developed by the Colorado Rare Plant Conservation Initiative. The Nature Conservancy, Boulder, Colorado. 117 pp.

Pipp, Andrea. 2024. Personal Communication. January. Montana Natural Heritage Program, Helena, MT.

Recovering America's Wildlife Act (RAWA). 2021. Bill to amend the Pittman-Robertson Wildlife Restoration Act. https://debbiedingell.house.gov/uploadedfiles/dingmi_138_xml.pdf [Accessed 28 January 2024].

Recovering America's Wildlife Act (RAWA). 2022. S.2372-Recovering American's Wildlife Act of 2022. https://www.congress.gov/bill/117th-congress/senate-bill/2372 [Accessed 28 January 2024].

Stein, Bruce A., and Kelly Gravuer. 2008. Hidden in Plain Sight: The Role of Plants in State Wildlife Action Plans. NatureServe, Arlington, Virginia. 28 pp.

Stockwell, Hope. 2021. *A Guide to the Montana Environmental Policy Act*. Legislative Environmental Policy Office, Helena, MT. https://leg.mt.gov/content/Publications/Environmental/2021-mepa-handbook.pdf

Szcodronski, Kimberly. 2023. Personal Communication. December 7th. Montana Natural Heritage Program Partners' Meeting. Montana Natural Heritage Program, Helena, MT.

Tallamy, Douglas W. 2009. *Bringing Nature Home*. Portland, OR: Timber Press. Pp. 360.

United Nations. 2024. https://www.un.org/en/global-issues/population. [Accessed 12 January 2024]

US Department of Interior (USDI), Bureau of Land Management. 2008. 6840 Special Status Species Management.

US Department of Agriculture (USDA), Forest Service. 2019. Flathead National Forest Land Management Plan. Kalispell, MT. 170 pp.

US Department of Agriculture (USDA), Forest Service. 2020a. Helena-Lewis and Clark National Forest Land Management Plan. Helena, MT. 244 pp.

US Department of Agriculture (USDA), Forest Service. 2020b. Custer Gallatin National Forest Land Management Plan. Bozeman, MT. 243 pp.

US Department of Agriculture (USDA), Forest Service. 2023. Regional Forester Sensitive Species of the Northern Region. Missoula, MT.

US Fish & Wildlife Service (USFWS). 2010. State Wildlife Grants-Mandatory Subprogram. https://www.fws.gov/policy-library/517fw10 [Accessed 29 January 2024]

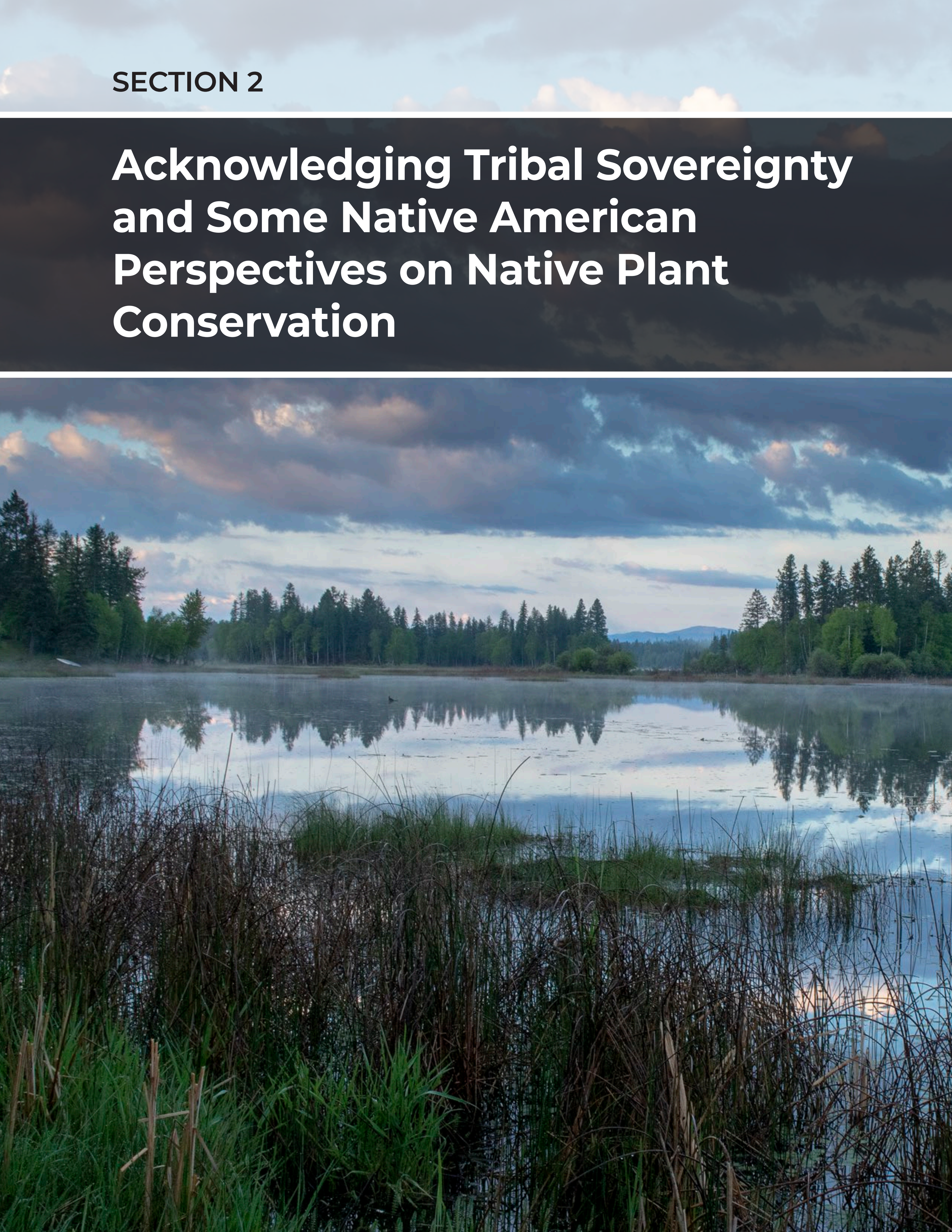
William A. Wallace, "David C. Lindberg, The Beginnings of Western Science: The European Scientific Tradition in Philosophical, Religious, and Institutional Context, 600 B.C. to A.D. 1450.", Speculum, Vol. 69, No. 4 (October 1994), 1211.

Wandersee, J. H., E. E. Schussler. 1999. "Preventing plant blindness". Amer. Biol. Teacher 61: 82-86.

Whyte, K., Gaughen, S., Hardison, H., Jones, C., Marks-Marino, D., Morishima, G., Mullen, H., & Walker, A. (2021). Worldviews, Knowledges, & Social Impacts. In *Status of Tribes and Climate Change Report* [Marks-Marino, D. (ed.)]. Institute for Tribal Environmental Professionals, pp. 34–45.

SECTION 2

Acknowledging Tribal Sovereignty and Some Native American Perspectives on Native Plant Conservation



SECTION 2
ACKNOWLEDGING TRIBAL SOVEREIGNTY AND SOME NATIVE AMERICAN PERSPECTIVES ON NATIVE PLANT CONSERVATION

An Acknowledgement to Native Americans in Montana

The development of a *Montana Native Plant Conservation Strategy* necessitates inclusion because all people who reside in Montana benefit from native plants. The Core Team of the *Montana Native Plant Conservation Strategy* acknowledges and honors the many Indigenous peoples[1,2], past and present, whose traditional homeland is the land that today we call the State of Montana. Being the original stewards, Indigenous peoples have developed the closest relationships to plants, lands, waters, animals, minerals, and other beings. What the Core Team presents is a Strategy that has strived for inclusion of people and organizations that share a vested interest in native plant species, habitats, and communities; it also includes components essential to plant conservation. This Strategy reflects input, ranging from little to lots, from a large and diverse assemblage of people and organizations, including some Native Americans from a few Tribes (see Table 1 on page iii). The Core Team recognizes that it is by no means comprehensive of all viewpoints. The Strategy, and its authors, value the rights and sovereignty of all Tribal nations and Native American peoples across Montana.

In this section of the *Montana Native Plant Conservation Strategy*, we provide basic information on Montana's federally recognized Tribal nations, share some Native American perspectives on native plant conservation, and suggest some general approaches or actions that can promote respectful dialogue and working relationships with Native American peoples. The following sections of the Strategy also include various conservation objectives that suggest ways to consider or include Native American views and practices in the statewide effort to sustain native plant species, habitats, and communities, and especially for those determined to be of Greatest Conservation Need.

Tribal Nations in Montana

Montana is home to eight federally recognized Tribal nations, who also own land (Table 2-1). These Tribal nations are the Confederated Salish and Kootenai Tribes of the Flathead Reservation; Blackfeet Nation; Chippewa Cree Tribe of the Rocky Boy's Reservation; Fort Belknap Indian Community, Fort Belknap Reservation; Fort Peck Assiniboine and Sioux Tribes; Northern Cheyenne Tribe; Apsáalooke Nation on the Crow Reservation; and the Little Shell Tribe of Chippewa Indians with lands on Mount Royal and other places (Table 2-1;

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[1] The usage of capitalization in the Strategy follows the conventions used in the *The Status of Tribes and Climate Change Report* (STACCWG 2021). "Indigenous", "Tribe", "Tribal" are capitalized while "people", "peoples", and "nation" are not unless denoting an official name.

[2] This Strategy uses the term "Indigenous peoples" in agreement with T*he Status of Tribes and Climate Change Report* (STACCWG 2021). The term is to be inclusive of self-determining societies whose political and cultural foundations pre-exist the formation of the United States, regardless of their recognition status by the US government. Indigenous peoples are also referred to as Native American people(s).

[3] Recommended sources to learn more about Tribal sovereignty, self-determination, and self government include:
-The Status of Tribes and Climate Change Report (STACCWG 2021):
https://www7.nau.edu/itep/main/docs/publications/ITEP.STACC.Report_2021.pdf
-Office of Tribal Justice-Native American Policies: https://www.justice.gov/otj/native-american-policies
-Montana Governor's Office of Indian Affairs: https://tribalnations.mt.gov/.

Figure 2-1). Montana is also home to Native American peoples representing other Tribes. Readers of the Strategy are encouraged to view each Tribal nation’s website (Table 2-1) to learn more about the people and their history, as well as to consult published literature.

Table 2-1. Contact information for the eight federally recognized Tribal Nations in Montana.

Confederated Salish & Kootenai Tribes
42487 Complex Blvd.
PO Box 278
Pablo, Montana 59855
https://csktribes.org/

Chippewa-Cree Tribal Council
R.R. 1, Box 542,
Box Elder, MT 59521
www.facebook.com/ChippewaCree

Northern Cheyenne Tribe
PO Box 128
600 Cheyenne Avenue
Lame Deer, MT 59043
www.cheyennenation.com

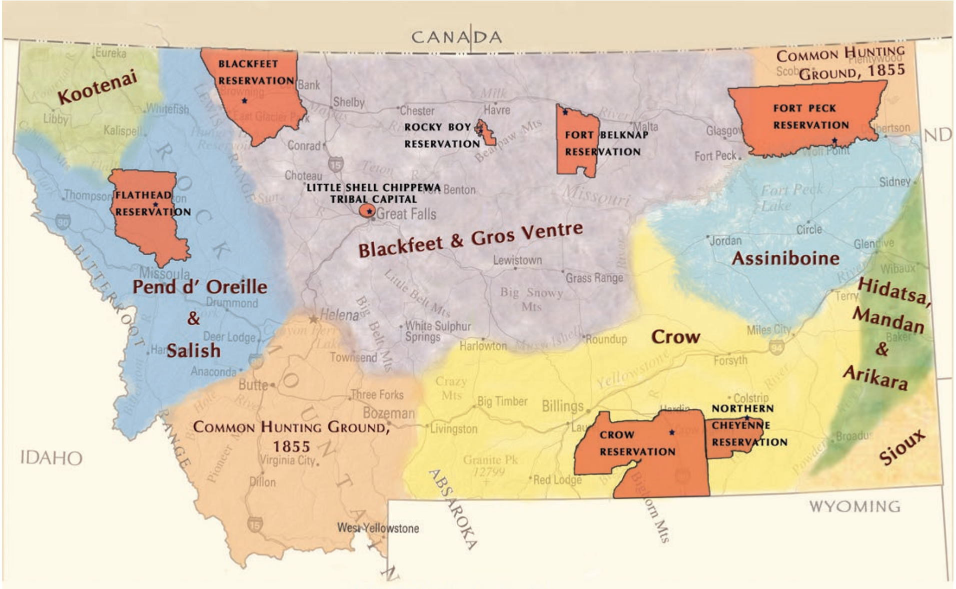
Blackfeet Nation
Blackfeet Reservation
PO Box 850 | All Chiefs Square
Browning, MT 59417
https://blackfeetnation.com/

Fort Belknap Indian Community of the Fort Belknap Indian Reservation
158 Tribal Way
Harlem, MT 59526
https://ftbelknap.org/

Fort Peck Assiniboine & Sioux Tribes
PO Box 1027
501 Medicine Bear Road
Poplar, MT 59255
https://fortpecktribes.org/

Little Shell Chippewa Tribe
625 Central Avenue West
Great Falls, MT 59401
https://montanalittleshelltribe.org/

Crow Tribal Council
P.O. Box 159
43 Heritage Lane
Crow Agency, MT 59022
http://www.crow-nsn.gov/


CANADA
Kootenai
BLACKFEET RESERVATION
ROCKY BOY RESERVATION
FORT BELKNAP RESERVATION
FORT PECK RESERVATION
COMMON HUNTING GROUND, 1855
FLATHEAD RESERVATION
LITTLE SHELL CHIPPEWA TRIBAL CAPITAL
Great Falls
Blackfeet & Gros Ventre
Assiniboine
Pend d' Oreille & Salish
Hidatsa, Mandan & Arikara
Crow
COMMON HUNTING GROUND, 1855
CROW RESERVATION
NORTHERN CHEYENNE RESERVATION
Sioux
IDAHO
WYOMING
ND
ROCKY MOUNTAIN
BITTERROOT RANGE
LEWIS RANGE
ABSAROKA
Eureka
Libby
Whitefish
Kalispell
Thompson
Missoula
Drummond
Deer Lodge
Anaconda
Butte
Helena
Townsend
Three Forks
Bozeman
Livingston
Virginia City
Dillon
West Yellowstone
Shelby
Conrad
Choteau
Chester
Havre
Benton
Malta
Glasgow
Fort Peck
Sidney
Circle
Jordan
Glendive
Wibaux
Terry
Baker
Miles City
Forsyth
Colstrip
Broadus
Lewistown
Grass Range
Big Snowy Mts
Little Belt Mts
Big Belt Mts
White Sulphur Springs
Harlowton
Roundup
Crazy Mts
Big Timber
Billings
Granite Pk 12799
Red Lodge
Bighorn Mts
Missouri
Yellowstone
Fort Peck Lake

Tribal Territories in Montana

Boundaries as defined by the Fort Laramie Treaty of 1851, and the Flathead and Blackfeet Treaties 1855.

🟥 Reservations today shown in red.

★ Star indicates location of tribal capital.

Names Tribes Call Themselves: A Key

Salish / Sqelio
Pend d’Oreille / Qæisp’e
Kootenai / Ksanka
Blackfeet / Niitsitapi (Pikuni)
Chippewa (Ojibwe) / Annishinabe
Plains Cree / Ne-i-yah-wahk
Gros Ventre / A’aninin
Assiniboine / Nakoda
Sioux / Lakota, Dakota
Northern Cheyenne / Tsististas and So’taa’eo’o
Crow / Apsaalooke
Little Shell Chippewa / Assishinabe and Métis

Figure 2-1. Tribal territories, as defined by the Fort Laramie Treaty of 1851 and the Flathead and Blackfeet Treaties of 1855[a] and current Tribal nation reservations and Tribal capitals in Montana (Thompson and Lugthart 2009).

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[a] In this map Tribal boundaries were determined by non-Indian officials during the time of developing these treaties and do not accurately reflect traditional Tribal Territories.

A Selection of Native American Perspectives on Native Plant Conservation[4]

On Native Plants

Native plants to Montana have been habitants on the land for time immemorial. They were the landscape, the earth, and continue to be the basis of life. They provide food and shelter for all living entities around them. This mutual respect has given them a high importance especial with Indigenous communities. The cultural value is ingrained in the Montana landscape and history. Native plants of Montana are traditional medicinal beings.

Native plants are living beings that feel, grow, and survive depending on the care they are given. They are not to be overharvested to the point of no return. Stories have been passed down from generation to generation on how traditional plants are to be used, harvested during what time of year, and how they are to be taken from the Earth. Each tribe is unique in their own teachings but the same respect for protocols is followed. One standard that is followed by most tribes is in leaving something when taking something from the earth. Whether that offering is tobacco or food, the items left are done with intention. Another great way to give back is to see and acknowledge the native plant, but to leave it in place to continue their life or to provide for other animals and future generations.

Today, these protocols are still very much in place. They reside and thrive within Native communities in Montana. The locations of traditional plants are kept with the community's knowledge, so they are not to be exploited. Seeking information as a non-indigenous individual it is very important to first ask for permission. Traditional Ecological Knowledge of native plants is valued to the highest extent for their existence as living beings. This knowledge is important for the betterment of all Montana communities and should be protected for the generations that follow. An effort in Montana is working towards creating sustainable collections of locally adapted native plant materials while also integrating Traditional Ecological Knowledge into ecological restoration practices. The Fort Belknap Indian Community partnered with the Montana/Dakotas Bureau of Land Management's Seeds of Success program and the Society for Ecological Restoration to develop a native seed and grassland restoration program[5]. This project not only contributes to native plant seed collections, but it also incorporates an understanding of the cultural importance of native plants to the Fort Belknap Indian Community.

On Wetland Plants and Habitats

Wetlands provide our tribes with traditional/cultural practices and spiritual well-being, which includes collecting plants for medicinal purposes, or for native craft making, and for subsistence, such as berry picking. These sacred places were created by Mother Earth and our brother the Beaver.

Many stories are told to us from generation to generation, as we are walking along with the "wise ones" (our grand-parents), when we are berry picking near wetlands. Hearing these stories makes us appreciate all the living things that depend on these wetlands.

We were always told to remember to leave something, an "offering", if we take something from this land, and to make sure we leave enough of the plants behind, so that it will grow back again to help us later. Also it was said by our elders that if a plant is growing in abundance, it was meant to be picked, so we pick from these areas, not the sites where the plant is limited or plants are scarce.

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[4] Authored by members of the Fort Belknap Indian Community

[5] Fort Belknap Partnership for Restoration: https://www.blm.gov/programs/natural-resources/native-plant-communities/about-native-plants/montana/fortbelknap

Cultural Practices include using Sage for cover scent when we are hunting and use native plants and mix with tobacco to make it sweeter tasting (Kinnikkinnick & Red Willow). Willows provide us many uses, including Tipi Stakes and binding, snares for traps, catching fish and many other crafts used around the camp such as dry meat hangers, and stakes for stretching and drying hides.

A Wetland Assessment Method may also include a cultural aspect that would be added into the matrix for scoring. For example, a wetland with lots of medicinal plants growing in it, would be classified as a High Priority site, opposed to one with good plant density and diversity, however lacking in what we would call, cultural values... meaning something we can use from the wetland site.

Conservation of wetland native plant species and habitats that considers Tribal or traditional cultural values sustains all beings. For example, a wetland with lots of native medicinal plants, in addition to other native plant density and diversity provides the most value, support, and greatest function on the landscape for all beings.

ACTIONS

ACTIONS TO IMPROVE WORKING RELATIONSHIPS WITH TRIBES AND NATIVE AMERICAN PEOPLES

1) Native American peoples' self-determination as practitioners of biodiversity conservation and ecological protection should be respected and reinforced (Whyte et al. 2021). Approaches to use, especially for proposed projects and species in vicinity of Tribal lands include, but are not limited to:
    - Collaborate across jurisdictions.
    - Consult and consent in the first stages of land and water planning, research, and management processes. This is especially important when the process involves native plants and habitats, especially lands and species of importance to Native American peoples.
    - Increase support mechanisms for the exercise of Tribal sovereignty.
    - Remove barriers to Native American peoples' rights to implementing land management practices.
2) Promote the retention of culturally valued plant species, on and off reservation, to help sustain Indigenous economies, Traditional Ecological Knowledge (TEK) systems, livelihoods, meanings, and identities (Whyte et al. 2021). Where retention is not possible, support Tribes in their efforts to make new relationships with newly arriving living beings.

3) Strive to develop respectful relationships with people of the Tribes and their communities through asking, listening, and discussing. Consider making planned site visits to talk in person. Work to understand that Tribal relations take time to establish and sustain.

ACTIONS

4) When proposing work on Tribal lands for culturally important plants, or for other beings, consider consulting with Tribal agency or Tribal college administrators or professors about the possibilities of working together, hiring student interns, conducting joint workshops and trainings, or getting help connecting with other community members to support mutual needs.

5) When addressing plant species in working documents, seek input and consider including, as appropriate, traditional Tribal names along with the scientific name.

REFERENCES

Status of Tribes and Climate Change Working (STACCWG), Marks-Marino, D. (ed.). 2021. Status of Tribes and Climate Change Report, Institute for Tribal Environmental Professionals, Northern Arizona University, Flagstaff, AZ.

Thompson, Sally, and Kim Lugthart. 2009. Tribal Territories in Montana Map on Montana Tribes website. A collaboration between The University of Montana and Indian Education at the Office of Public Instruction. https://montanatribes.org/ [26 April 2024]

Whyte, Kyle, S. Gaughen, H Hardison, C. Jones, D. Marks-Marino, G. Morishima, H. Mullen, and A. Walker, (2021). Worldviews, Knowledges, and Social Impacts. In *Status of Tribes and Climate Change Report* [Marks-Marino, D. (ed.)]. Institute for Tribal Environmental Professionals, pp. 34–45.

SECTION 3

Strengthening Botanical Capacity in Montana

SECTION 3
STRENGTHENING BOTANICAL CAPACITY IN MONTANA

BOTANICAL CAPACITY

Montana is a place rich in both plant species diversity and botanical knowledge that comes from Indigenous peoples, emigrants, and a long history of botanical exploration, all of which continue today. Collectively, people have been building botanical capacity since inhabiting the lands that today we call the State of Montana. Yet the recognition and power of this accumulated botanical knowledge and capacity have at varying times been fractured or eroded, and now requires an awakening if we are to conserve Montana's native flora in this rapidly changing world.

Botanical capacity is the human, scientific, technological, organizational, institutional, and resource capabilities that support plant-based education and training, basic and applied research, and environmental monitoring and management (Kramer et al. 2013; Kramer et al. 2010). Botanical capacity is critical to conserving, maintaining, and managing the diversity of Montana's native flora, and the many important ways that plants sustain people, animals, and habitats (Box 3-1). This section, *Strengthening Botanical Capacity in Montana*, hereafter *Botanical Capacity*, addresses the ways people have gained, retained, fractured, and eroded capacity; the need to embrace its components and complexity; and identifies conservation objectives to strengthen Montana's botanical capacity.

Box 3-1. How botanical capacity is defined at the statewide level by the authors of the ***Montana Native Plant Conservation Strategy*****.**

Botanical Capacity is viewed as the knowledge, appreciation, and stewardship of plants and habitats by individual people, their communities, and their cultures (Indigenous and western) across multiple generations.

- Knowledge is gained and shared by people through oral and written communication, scientific studies, and personal observations and experiences.
- Appreciation of plants and habitats comes with reverence for life and is intricately linked to human health and well-being.
- Stewardship of plant and habitat resources requires human leadership, networking, and communication in both oral and written forms, and is manifested in respectful interactions and with the sustainable use of our natural and physical resources.

Botanical Capacity involves, and often relies upon, the capabilities of organizational and institutional resources, such as colleges and universities; herbaria; botanic gardens; places with jurisdictional authority (national forests; wilderness areas; national, state, county, and city parks; Tribal lands; wildlife refuges; etc.); state, federal, local, and tribal management agencies; private landowners; non-profits and NGOs; financial systems; and numerous others.

Botanical Capacity is often correlated with the capabilities of physical, financial, technological, and human resources, such as small and large businesses (plant nurseries; consultants; farmers, ranchers, and other private landowners; small or large companies; corporations; extractive industries; etc.); funding opportunities (grants and donations); financial institutions and investments; technology (equipment; environmental engineering; etc.); and people (leadership; skilled workforce; etc.); and numerous others.

Components of botanical capacity vary by place within Montana.

What does botanical capacity mean to you?

> *The study of plants and the application of knowledge gained is perhaps humanity's oldest and most important endeavor, particularly when it comes to the environment and human health.*
>
> ~ Andrea Kramer,
> Barbara Zorn-Arnold, and
> Kayri Havens (2010)

Sources of Botanical Knowledge in Montana

To understand what has been gained, we need to first look at how botanical knowledge arose in Montana.

Indigenous Peoples

The growth of botanical knowledge in Montana is well illustrated in *Montana's Pioneer Botanists - Exploring the Mountains and Prairies*, which pays homage to and tells of the First People, Montana's first botanists, and of the many European explorers whose botanical travels began in the 1800s (Potter and Lesica (eds.) 2017). Indigenous peoples have for thousands of years accumulated botanical knowledge on their ancestral lands. Their reliance on the land required an intimate knowledge of plants, passed down via oral tradition (Luna, Matt, and Gopher *in Montana's Pioneer Botanists* 2017). Montana's many Tribes used the plants specific to their unique homelands and Tribal customs for foods, medicines, spiritual needs, implements, and shelter. Plants are entwined with each Tribe's culture, environment, and landscape, guiding them on the use of the land and through the changing seasons. Native people's relationships with plants and animals led to a profound understanding of ecology and the development of practices to ensure the continuation of life.

European Immigration

The beginning of the 1800s saw the start of a different kind of botanical exploration. It arrived with what would become a wave of European explorers, eager to document the plants and animals of this "new" land we now call Montana. These 19th and 20th Century botanical explorers were ministers, doctors, professors, entrepreneurs, traders, and others, self-taught or formally trained in botany, and

Photo Credit: Dee Blank

Photo 3-1. Native grassland along the Rocky Mountain Front near Dupuyer Creek in June.

paid on commission or just pursuing their personal interests. The most skilled European plant explorers paid at least some attention to the immense knowledge of the Tribes whose lands they travelled through, listened to their guides, and watched what women gathered and cooked (Nisbet *in Montana's Pioneer Botanists* 2017). Many explorers gained botanical knowledge through interactions with people, observing plants in the natural world, and by formal education. They shared their botanical knowledge by collecting and depositing plant specimens into agency and university herbaria to further scientific studies and also by publishing their findings.

Expansions, Declines, and Shifts in Botanical Capacity in Montana

Botanical knowledge, whether gained by western culture or Indigenous cultures, has accumulated through time and expanded in ways that include institutions, organizations, and technology. Yet this accumulation and expansion has not occurred at the same time, nor for all parts of the population equally, effectively reducing botanical capacity and hindering plant conservation (see Section 1, Need for a Statewide Native Plant Conservation Strategy, #2). Meanwhile what plants, species diversity, and plant communities offer to humanity has not changed.

Montana's Western Cultures

The arrival of European settlers brought numerous changes that altered the biological history of North America (Noss and Cooperrider 1994) and the nature of its botanical capacity. With European settlement came different world views, the taming of habitats, and loss of biodiversity (Noss and Cooperrider 1994), along with the quest for scientific knowledge. Settlement and the pursuit of scientific studies, supported by an established US government, grew our nation's botanical capacity, and expanded Montana's in new ways. Some pioneers brought seeds of plants important to their heritage, and many made permanent homesteads. The government created land designations and management agencies that helped promote the disciplines of forestry, agriculture, range science, botany, ecology, and others.

Photo Credit: Robyn Klein

Photo 3-2. Field-based classes that incorporate botanical keys boosts both observation and plant identification skills.

Central to these disciplines were the universities, institutions of research and teaching, and later various extension services that applied the research and new knowledge to practices used by landowners. From at least the mid-1950s, various state and private colleges and universities in Montana offered degrees, laboratories, and/or a spectrum of coursework in botany and other plant sciences. Specialties, shifting trends in subject matter (cellular, taxonomy, ecological, molecular, genetics, etc.) and organisms (vascular, non-vascular, fungi, algae, etc.) to study kept botany in its heyday into the 1990s. These trends permeated the government and private work force and agricultural communities, as well, leading to an expansion of botanical capacity in Montana. Many of Montana's ranchers and farmers also possessed intimate knowledge of the native flora on their lands, and participated in or organized events, such as rangeland plant identification workshops. To date, few states can claim, as Montana can, published statewide floras for all major taxa: vascular plant (Lesica 2012 and 2022; Booth 1950; Booth and Wright 1966), moss (Elliott and Pipp 2020; Elliott 1993), liverwort (Hong 2002), lichen (McCune et al. 2014), diatoms (Bahls 2021 and 2023), algae (Prescott and Dillard 1979), and (in development) a fungal checklist by Wheeler and Cripps (Montana Natural Heritage Program 2024) (see Box 5-1). Most of these have also been revised or recently published.

In recent times, botanical capacity has declined across our nation's academic institutions and land management agencies. Between 2000 and 2008, undergraduate degrees earned in botany declined by 50%, while degrees in biology rose by 17% (Kramer et al. 2013). A 2009 survey found that almost 40% of more than 400 university faculty respondents said that botany courses in their department had been cut since 2000 (Kramer et al. 2013). The national decline has also affected the work force, with employers struggling to hire adequately trained botanists (Kramer et al. 2013). These concerns have been echoed by several members of this *Strategy's* partnership. The impact today is a significant loss in botanical capacity in academic and government sectors.

For Indigenous peoples, access to higher education and the ability to complete degrees did not begin until 1968 with passage of the Navajo Community College Act (Shanley 2006). It wasn't until the 1970s that the movement to establish Tribal colleges came to Montana (Shanley 2006). By 1984, each of Montana's seven Indian reservations instituted a two- or four-year college (Shanley 2006). After their establishment, Tribal colleges sought accreditations. Each is governed by a Board of Directors without a direct relationship to the Montana University System. In addition, each Tribal college has a mission to maintain the language, history, culture, and world view of their respective Tribal affiliation(s). This mission is perhaps the most challenging to meet in today's changing world (Shanley 2006). During the 2003-2004 academic year in Montana, there were 6,413 Native American students attending college or university, of which 77.5% were enrolled in a Tribal college. While Tribal colleges struggle with budgets, staffing, and rural locations, they have developed into stable, productive institutions that provide higher education to their Tribal citizens, thus empowering their communities and building botanical capacity.

Montana's Indigenous Cultures

While institutional botanical knowledge has flourished at times and for some of Montana's population, traditional botanical knowledge for Indigenous peoples declined. Passed down through each generation, traditional botanical knowledge is directly interwoven into Tribal identity, language, kinship, families, communities, and culture (Gopher 2024). The Native worldview includes the totality of all living and physical beings which are inseparable from the People. After the signing of treaties, many US laws, policies, and practices led to the loss of access and inherent rights to the lands, water, plants, and animals for Indigenous people (Whyte et al. in Status of Tribes and Climate Change Working Group (STACCWG) 2021). The loss has not only been in generational knowledge, but also in the spiritual origins and the understanding of how this knowledge fits with the ancestral teachings of the specific Tribe (Whyte et al. in STACCWG 2021). Consequently, Indigenous peoples have had to work ingeniously to create legal and policy avenues to recover and protect their lands and self-government (Shanley 2006; Whyte et al. in STACCWG 2021).

Despite obstacles, there has been a resurgence in traditional plant knowledge and practices, in part due to the recognition that this knowledge is threatened by rapid conversion to technology, environmental change, and most recently, the pandemic. Traditional societies and key people within Tribes, such as traditional plant gatherers, want to continue to pass on this knowledge, recognizing that some plants have been impacted by climate change, and others are no longer present on the landscape (Edmo 2024). Gatherers also emphasize the significance of passing on knowledge within each seasonal round to foster continual knowledge, as well as noting plant responses to environmental changes. Cultural practices, such as the timing of gathering plants, as well as desired plant properties, are also changing due to recent climate warming (Gopher 2024). Native peoples have also preserved knowledge of the land's flora through their own native plant collections, such as the Fort Belknap Indian Community, Vascular Native Plant Collection 2010 (Longknife 2024).

The future of each Tribal Nation rests solely in each Tribe's successive generation and their individual ability to protect culturally significant plants (Grant 2024). As relayed by Dennis Longknife (2024) of the Fort Belknap Indian Community, "A nationwide resurgence of 'Immersion & Language Preservation' going on at most reservations is returning what has been on the brink of being lost to real-life teachings. Educating our children allows them to pass this on to the next generation. One Native American book talks about the Seven Generations, and today our children are our Seventh Generation; the seventh generation are the ones that will empower peoples. Our ways of knowing and life go on, we never lost it, we just never shared it."

Steps That Strengthen Botanical Capacity in Montana

It is clear that Montana has a rich and long history of botanical knowledge gathered by all its inhabitants, and lands that still retain large areas of biologically diverse native habitats, from fragmented to fully intact. Despite these assets, components of botanical capacity in Montana are also localized, dispersed, or fragmented across this fourth largest state. Collaborative efforts and definitive actions are needed to reverse the five constraints that have

Photo Credit: Mason Lech

Photo 3-3. Citizen botanists from the Montana Native Plant Society-Flathead Chapter host a workshop to learn how to conduct site visits to rare plant locations.

hampered plant conservation and hindered botanical capacity (see Section 1, Need for a Statewide Native Plant Conservation Strategy, #1-5). Moreover, the Native perspective and traditional knowledge are key to ensuring cultural survival and resilience in addition to helping to achieve many of the recommended plant conservation objectives. We must work on a variety of fronts to strengthen botanical capacity in order to conserve native plants, including Plant Species, Unique Habitats, and Plant Communities of Greatest Conservation Need (GCN).

In strengthening botanical capacity, the essential roles that skilled botanists provide in education, land management, monitoring, and research must be recognized. Botanical competencies can be gained through a variety of means, and result in a diverse skill set, such as in plant identification, plant restoration techniques, designing monitoring studies, and developing seed mixes. As such, botanists are versatile and known by many names. Those with specific botanical skills may work as habitat biologists, natural resource specialists, rangeland specialists, foresters, biologists, ethnobotanists, plant nursery workers, professors, teachers, plant taxonomists, wetland delineators, landowners, landscapers, naturalists, curators, botanists, or in other capacities. What people with botanical skills share is an interest in plants, an ability to notice characteristics of a species, and appreciate our reciprocal nature with them. People who develop good botanical skills expand botanical capacity regardless of their job title.

CONSERVATION GOALS & OBJECTIVES FOR STRENGTHENING BOTANICAL CAPACITY

As we seek to strengthen botanical capacity, it's clear that new communication technologies and ways of viewing the world require botanists to do their work differently. Yet our dependence on native plants, and the reliance by other species, has not changed. Here in the *Strengthening Botanical Capacity* section of the *Strategy*, we present goals and suggest overarching conservation objectives from four areas that are pillars of botanical capacity:

- Information Needs [Inventory, Monitoring, Research]
- Protection and Restoration
- Outreach and Education
- Policy and Regulation

The following specific goals and objectives for strengthening botanical capacity would retain and grow an educated, informed, engaged, and coordinated botanical network across the state. These goals and conservation objectives were developed by a large partnership who shared their own expertise and experiences, consulted literature, and/or discussed topics through interviews and meetings from 2018 to 2024. Input was provided by professional and retired botanists, educators, biologists, and herbarium curators representing federal and state land management agencies, Tribal nations, non-governmental conservation organizations, Montana Natural Heritage Program, academia, and other organizations, all of whom are concerned that botanical capacity is valued, supported, and used to reverse constraints in plant conservation. These voluntary actions can be pursued or implemented by a single entity, or as a collaborative effort by individuals, agencies, and organizations. They are presented in no prioritized order.

Information Needs [Inventory, Monitoring, Research]

Conservation Goal

Strengthen botanical capacity within and among organizations through information sharing and while respecting organizational responsibilities and missions.

Conservation Objectives

1) On the Montana Natural Heritage Program (MTNHP) website[1], develop a page to host the *Montana Native Plant Conservation Strategy.* An online resource would centralize information that is pertinent to working across jurisdictions and improve coordination for implementing the Strategy. The web page could include, but is not limited to, the following:
   - *Montana Native Plant Conservation Strategy* and developed, updated, or revised components. If password-protected, the web page could also store internal information and literature important to partnering organizations, but not for the general public.
   - Internal links to other publicly accessible portions of the MTNHP website, particularly the Montana Field Guide.
   - Species- and habitat-specific monitoring plans, survey techniques, best management practices, educational materials, seed collection and propagation guides, brochures, and other products.
   - Direct links to other websites, web pages, and online documents from other organizations that pertain to the *Strategy.*
   - Password-protected access to allow partnering organizations to post and update Strategy-relevant information (see #3 below).

Photo Credit: Andrea Pipp

*Photo 3-4. Monitoring Lemhi Beardtongue (*Penstemon lemhiensis*) on the Big Hole National Battlefield. Botanists from the MTNHP and USFS assist a team of ecologists from the National Park Service-Upper Columbia Basin Network.*

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[1] Montana Natural Heritage Program: https://mtnhp.mt.gov/

Information Needs [Inventory, Monitoring, Research]

2) Create a Strategy Stewards Committee that coordinates the botanical community to maintain the *Strategy's* relevance; assists with the development of relevant working groups; develops conservation profiles for identified Plant Species, Unique Habitats, and Plant Communities of GCN; updates or revises existing sections; and provides overall support for implementing the *Strategy* (refer to Section 1, Box 1-2). The Core Team envisions a Strategy Stewards Committee composed of at least seven members represented by the following organizations[13]:
    - MNPS - Conservation Committee member;
    - MTNHP - botanist and ecologist;
    - USFS Region 1 - Regional botanist;
    - MT/Dakotas BLM - State botanist;
    - MFWP - plant ecologist;
    - MTDNRC - forest ecologist; and
    - Tribal nation - ethno-botanist

3) Help continue to develop and implement the *Montana Native Plant Conservation Strategy* by reaching out to the Strategy Stewards to initiate involvement and/or contribute information. Ways to get involved and/or share publicly available information include, but are not limited to:
    - Implement a conservation objective or complete a task of a similar nature to that mentioned in a particular section of the *Strategy*, such as in Native American Perspectives on Plant Conservation; Strengthening Botanical Capacity; Plant Species of GCN; Unique Habitats of GCN; Plant Community of GCN; Montana's Herbaria; and Native Pollinator Plants. Share - results, lessons learned, or other components on the *Strategy's* web page.
    - Implement a conservation objective or complete a task of a similar nature to that mentioned in an established conservation profile (see Appendices A-Plant Species of GCN, B-Unique Habitats of GCN, and C-Plant Communities of GCN). Share results, lessons learned, or other components on the *Strategy's* web page.
    - Lead a working group to develop a conservation profile for a Plant Species, Unique Habitat, or Plant Community of GCN identified in the *Strategy*. Provide the draft conservation profile to the Strategy Stewards for review and potential inclusion on the *Strategy's* web page.
    - Provide published literature and unpublished reports on Plant Species, Unique Habitats, or Plant Communities of GCN to the Strategy Stewards for inclusion on the *Strategy* website. Examples include conservation strategies; monitoring plans, techniques, or reports; assessment or status reports; scientific publications; agency publications; brochures/ pamphlets; and any pertinent and informative document.
    - Collaborate on research - identified as a conservation objective or of a similar nature - relative to the specific Plant Species, Unique Habitat, or Plant Community of GCN. Share results, lessons learned, or other components on the *Strategy's* web page.
    - Collaborate on and/or develop management recommendations, best management practices, or other management strategies relative to a Plant Species, Unique Habitat, or Plant Community of GCN. Share future results, lessons learned, or other components on the *Strategy's* web page.

Information Needs [Inventory, Monitoring, & Research]

4) Support and fund the development of a MTNHP-MNPS co-managed Montana Citizen Botany Program[2]. An established program would support plant conservation by connecting a network of qualified citizen scientists (possessing basic botanical skills, knowledge, and interests) to federal, state, private, and non-governmental organizations to carry out inventory, monitoring, seed collecting, and other plant-focused tasks. Actions that would support a Montana Citizen Botany Program include, but are not limited to:
    a. Contribute financially to the Montana Native Plant Society to fund an MNPS Coordinator (position or contractor) and develop a User Interface (UI) on the MNPS website.
    b. Apply to be a Citizen Botanist volunteer or recruit others.
    c. Engage land managers to coordinate with the MTNHP Botanist and MNPS Coordinator to develop plant-based citizen science projects that are appropriate and implementable to help achieve land management goals.
    d. Teach or provide training opportunities to existing Citizen Botanists on plant identification, monitoring techniques, field skills, data collection, mapping techniques, and other related topics.
5) Participate in the Montana Native Plant Conservation Conference[3], organized by the Montana Native Plant Society and held every two years.
6) Recognize the Montana Department of Natural Resources and Conservation (MTDNRC) nursery as the production hub of the Montana Native Seed Network (MTNSN) which serves to facilitate research that could include, but is not limited to:
    a. Conduct common garden studies involving Plant Species of GCN and other native plants. Studies can examine and inform practitioners about species' adaptability to climate change and life history traits.
    b. Cooperative studies with faculty at University of Montana, Montana State University, or other Montana educational institutions and research facilities.
7) Consult the technical reference *Measuring and Monitoring Plant Populations* (Elzinga et al. 1998[4]) when developing botanical or ecological objectives or management goals; designing research and

Photo Credit: Andrea Pipp

Photo 3-5. On a Montana Native Plant Society field trip, attendees test a mapping app and survey for Geyer's Lomatium (Lomatium geyeri)*, a Montana SOC.*

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[2] A Proposed Framework for Developing A Montana Citizen Botany Program: https://mtnhp.org/Reports/BOT_CitizenBotany_ProposedFramework_2022.pdf

[3] Montana Native Plant Society – Plant Conservation Conference: https://mtnativeplants.org/conservation-conference/

[4] Measuring and Monitoring Plant Populations (Elzinga et al 1998) available at: https://www.ntc.blm.gov/krc/legacy/course/265

Information Needs [Inventory, Monitoring, Research]

monitoring methods; determining sampling unit, objectives, and design; selecting field techniques for measuring vegetation; conducting statistical and other analyses; and managing data for plant-focused projects.

8) Work collaboratively with Montana's Tribal nations, Tribal Historic Preservation Officers (THPO), Montana State Library, Montana State Historical Preservation Office (SHPO), regional and local libraries and museums, and/or others, to identify published ethnographic, ethnobotanical, and historical studies that contain Traditional Knowledge and biodiversity data to ensure their retention and to make them publicly available through loans and digital formats. Published sources include publications, books, theses, dissertations, databases, or other formats. Many publications produced from the 1800s to the late 1900s are invaluable records that are out of print or held in specific institutions and may not be readily available to the public.

Protection and Restoration

Conservation Goal

Secure on-the-ground, site-specific habitat and/or management protection and promote sustainable collection, production, and planting of state-sourced native plant materials in restoration, remediation, and reclamation projects.

Conservation Objectives

1) Support MFWP-administered programs that help conserve native habitats. These programs directly benefit native plants and Plant Species of GCN where they occur within Wildlife Management Areas (WMAs), Conservation Easements (CEs), conservation leases, and other habitat enhancement and restoration programs. These programs indirectly benefit native plants because they maintain the integrity and resiliency of native habitats for animal pollinators and native plant species and are managed to reduce invasive species and improve the ecological function of degraded habitats. Significant MFWP[5] programs to support include:
   a. **Habitat Montana**[6]
      - WMAs: Seventy sites (about 454,000 acres) are managed to benefit wildlife. Plant Species of GCN have been documented in or adjacent to many WMAs.
      - CEs: Approximately 100 easements covering about 634,000 acres of private lands throughout the state are managed to conserve or improve wildlife habitat, implement soil and water conservation, improve ecological function, reduce urban sprawl, increase open space, and maintain rural and agricultural economies.

   b. **Wildlife Habitat Improvement Program (WHIP)**[7]
   This grant program manages noxious weeds on priority wildlife habitats to restore native plant communities.

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[5] MFWP program reflect information provided in winter of 2023.

[6] Habitat Montana: https://fwp.mt.gov/conservation/landowner-programs/habitat-montana

[7] Wildlife Habitat Improvement Program: https://fwp.mt.gov/aboutfwp/grant-programs/wildlife-habitat-improvement

c. **Habitat Conservation Lease Program**[8]
This program funds 30- or 40-year conservation leases for priority wildlife habitats on private lands, such as for Greater Sage-Grouse (*Centrocercus urophasianus*) habitat, mixed grass prairie, and wetland complexes. The goal is to protect about 500,000 acres of prairie and other types of habitat within the plains.

d. **Future Fisheries Improvement Program**[9]
This grant program funds restoration projects involving rivers, streams, lakes, fish habitat, and associated riparian areas.

e. **Migratory Bird Wetland Program**[10]
This program restores, enhances, or creates wetland habitat for migratory birds and provides permanent protection for unprotected wetlands and associated grasslands. This program has been implemented on grasslands (9,807 acres) and 633 wetlands (5,162 acres, of which 3,700 have been permanently protected).

f. **Candidate Conservation Agreement and Assurances (CCAA)**[11]
This program has benefited the Arctic Grayling in the Big Hole and Centennial Valleys with more than 500 habitat projects, many of which address riparian habitat.

2) Through partnerships, staff time, equipment, and/or funding, help establish the Montana Native Seed Network (MTNSN) by 2028. The MTNSN will bring together public and private conservation practitioners who work in the native seed industry to produce ecotype seeds from Montana's wild populations to restore habitats.

3) Strengthen Montana's native plant material supply chain by fostering partnerships between the public and private sectors. Through contract growing, The MT DNRC Nursery and MTNSN aim to increase private sector capacity to include commercial seed growers and private nurseries, thus ensuring the availability of genetically appropriate native plant materials for restoration.

4) Work with strategic partners to compile a list of successful native plant restoration projects to showcase on the proposed *Strategy* web page or use as demonstration sites. Potential sources for identifying locations of successful native plant restoration projects include:
   - MNPS Small Grants Program. This grant program has funded numerous native plant garden and restoration projects.
   - 2008 and 2024 Montana Plant Conservation Conferences[12] that showcased monitoring and restoration techniques.

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[8] Habitat Conservation Lease Program: https://fwp.mt.gov/conservation/habitat/habitat-conservation/lease-program

[9] Future Fisheries Improvement Program (MFWP 2023): https://fwp.mt.gov/ffip

[10] Migratory Bird Wetland Program: https://fwp.mt.gov/conservation/habitat/migratory-bird-wetland-program

[11] Candidate Conservation Agreement and Assurances: https://fwp.mt.gov/conservation/fisheries-management/arctic-grayling

[12] Montana Plant Conservation Conference links to past proceedings are at: https://mtnativeplants.org/conservation-conference/

- MTDNRC Nursery. With funding and staff support, develop a tracking system for seed-based restoration projects that use MTNSN ecotypes. A tracking system can gather pertinent information on how ecotype seeds are used and their growth, survival, and success rates.

5) Develop a restoration working group to address statewide topics with native plants. Alternatively, this could be part of the MTNSN.

    a. A restoration working group should include stakeholders from:

        - Private industry. E.g., nurseries, consultants, seed producers, Montana Nursery and Landscape Association.
        - Federal and state plant nurseries. E.g., NRCS, MTDNRC, MTNSN[13].
        - Federal and state land managers. E.g., BIA, BLM, NPS, USFS, USFWS, MDA, MTDEQ, MTDNRC[13].
        - County planning departments.
        - Tribal nations. E.g., Tribal colleges, Elders, ethnobotanists, plant gatherers, biologists, cultural directors, administrators.
        - NGOs. E.g., TNC, Montana Seed Growers Association, MNPS[13].

    b. Investigate business models, economics, laws, and other factors that influence the establishment and success of Montana businesses that grow, buy/sell, or supply Montana-derived native plant materials (seed, bare root plants, containerized stock, etc.) to make recommendations. There are significant concerns that the supply of Montana-based native plant materials is insufficient to meet needs and that many plant material sources are not preserving local or regional genetics. The panel addressing this topic should include stakeholders listed under 5a plus economic and business professionals from state departments (MDA, Labor and Industry, Commerce) business consultants, and/or others.

    c. Research to develop 'voluntary best practices' for situations where a ground-disturbing activity may harm Plant Species of GCN, SOC, PSOC, including avoidance, mitigation, salvage, transplanting, translocation, etc. Informed best practices are needed. General consensus is to avoid harm and only consider transplanting into unoccupied, verified habitat as an absolute last step to saving plants.

Photo Credit: Andrea Pipp

Photo 3-6. A USFS botanist on the Beaverhead-Deerlodge National Forest collects Lemhi Beardtongue (Penstemon lemhiensis) *seeds as part of the Seeds for Success program.*

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[13] Refer to the Acronyms and Abbreviations section in the *Strategy*.

6) Adhere to established native seed and plant collecting guidelines. For organizations that lack guidelines, consider consulting these sources:
   - Guidelines for Collecting Native Plants (MNPS 2003)[14]
   - Plant Collection Guidelines for Teachers (MNPS ND)[15]
   - Seeds of Success Guides and Training Resources[16]
   - Native Traditionalists and traditional protocols

7) Consult Montana-developed resources when growing native plants and conducting restoration. Montana-based resources include, but are not limited to:
   - MNPS Native Plant Landscaping[17] web page:
     -*Montana Native Plant Source Guide* (MNPS 2024)
     -*Germination of Wildland Collected Seed* (Majerus 2022)
   - MTDNRC Forestry Assistance and Trust Lands Division[18]
   - Montana Conservation Seedling Nursery (CNRC)[19]
   - Links to more resources are in Section 8-*Native Plants and Pollinators* of this *Strategy.*

Photo Credit: Peter Lesica

Photo 3-8. A Spalding's Catchfly (Silene spaldingii) *seedling successfully grown from Montana sourced seeds and native grassland innoculum.*

8) Consult other plant-focused strategies and planning efforts, as appropriate, to maximize conservation efforts across jurisdictional boundaries when developing restoration projects for Plant Species, Unique Habitats, and Plant Communities of GCN, and other native plants. Strategies to consult include, but are not limited to:
   - National Seed Strategy:
     - Rehabilitation and Restoration[20]
     - Business Plan[21]
   - National Academies: An Assessment of Native Seed Needs and Capacities (2023)[22]
   - USFS Native Plant Materials Policy: A Strategic Framework (2012)[23]

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[14] MNPS 2003 Collecting Guidelines: https://mtnativeplants.org/wp-content/uploads/2018/07/MNPS-Guidelines-for-Collecting-Native-Plants-.pdf

[15] MNPS ND Plant Collecting Guidelines for Teachers: https://mtnativeplants.org/wp-content/uploads/2018/07/MNPS-Plant-Collection-Guidelines-for-Teachers.pdf

[16] Seeds of Success Guides and Training Resources: https://www.blm.gov/programs/natural-resources/native-plant-communities/native-plant-and-seed-material-development/collection

[17] MNPS Native Plant Landscaping: https://mtnativeplants.org/native-plant-landscaping/

[18] MTDNRC Forestry Assistance and Trust Lands Division: https://dnrc.mt.gov/TrustLand/

[19] CNRC: https://dnrc.mt.gov/forestry/Conservation-Nursery/

[20] National Seed Strategy-Rehabilitation and Restoration: https://www.blm.gov/sites/blm.gov/files/docs/2020-12/NationalSeedStrategy_2015-2020.pdf

[21] National Seed Strategy-Business Plan: https://www.blm.gov/sites/blm.gov/files/uploads/programs_natural-resources_native-plant-communities_national-seed-strategy_NSS-BUSINESS-PLAN.pdf

[22] An Assessment of Native Seed Needs and Capacities (2023): https://www.nationalacademies.org/our-work/an-assessment-of-native-seed-needs-and-capacities

[23] USFS Native Plant Materials Strategic Framework (2012): https://www.fs.usda.gov/wildflowers/Native_Plant_Materials/policy.shtml

- Montana Forest Action Plan (2020)[24]
- North American Botanic Garden: Strategy for Alpine Plant Conservation[25]
- Botanic Gardens Conservation International: Global Strategy for Plant Conservation[26]

9) Consult culturally focused strategies and planning efforts, as appropriate, to maximize conservation efforts across jurisdictional boundaries when addressing historical, cultural, and ethnobotanical records, publications, studies, and other plant-related materials, including those related to Plant Species, Unique Habitats, and Plant Communities of GCN. Strategies to consult include, but are not limited to:
    - The Montana Historic Preservation Plan, 2023-2027: Past, Present, and Future (Montana SHPO 2023)

10) Collaborate with domestic botanical gardens to conserve plant species. Recommended botanical gardens include, but are not limited to:
    - Rae Selling Berry Seed Bank, Portland State University, Oregon[28]
    - Denver Botanic Gardens[29]

11) Promote the understanding and use of the Reserved Treaty Rights Lands Program (RTRL) between Montana's Tribes and landownerships outside of Tribal properties. This is inclusive of federal, state, private and other lands where the exclusion of fire has compromised the resiliency and health of priority Tribal natural resources. The RTRL is a funding program administered by the Bureau of Indian Affairs (BIA). As an example, this program is assisting the Confederated Salish and Kootenai Tribes, The Nature Conservancy, and the MT/Dakotas Bureau of Land Management in restoring Common Camas (*Camassia quamash*) populations.

12) Create opportunities to obtain guidance and assistance from Tribes in ways that apply TK protection, preservation, and restoration practices, as appropriate, when conserving and maintaining native plant populations, including Plant Species of GCN.

13) Acknowledge and respect TK, cultural practices, and cultural protocols when handling or collecting traditional plants, including Plant Species of GCN, and their plant parts (seeds, bark, root segments, etc.). When making herbarium specimens, collect only the upper portion and leave the root system so the plant may regenerate.

14) Work with Sustainable Forestry Initiative (SFI) to advance sustainably managed forests and associated G1-G2 Plant Species of GCN and SOC. Use and support SFI standards, certifications, and labelled-products: https://forests.org/

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[24] Montana Forest Action Plan (2020): https://dnrc.mt.gov/_docs/forestry/Montana_Forest_Action_Plan_12.22.2020.pdf

[25] Strategy for Alpine Plant Conservation: https://alpinestrategy.org/

[26] Global Strategy for Plant Conservation: https://www.bgci.org/our-work/inspiring-and-leading-people/policy-and-advocacy/the-global-strategy-for-plant-conservation/

[27] The Montana Historic Preservation Plan, 2023-2027: https://mhs.mt.gov/Shpo/docs/MontanaStatePlan_2023_2027.pdf

[28] Rae Selling Berry Seed Bank: https://www.pdx.edu/seed-bank/

[29] Denver Botanic Gardens: https://www.botanicgardens.org/

Outreach and Education

Conservation Goal

Overcome gaps in botanical knowledge, promote plant appreciation through education, training, and teaching of culture and natural heritage, and foster plant-based experiences to combat disconnection with our natural world and guide solutions to environmental problems.

Conservation Objectives

1) Advocate for Montana's institutions of higher education to add (back in) botanical coursework and/or degrees. Botanical coursework and curricula should also meet federal employment requirements for the Botany Series 0430. Higher-level botanical coursework and/or degrees are needed to offset the loss of botanical expertise and under-appreciation of plants, which hinder plant conservation efforts (see Section 1-*Need For a Statewide Native Plant Conservation Strategy*, #2).

2 Explore the development of a Montana-based botanical certification program that would allow professionals, skilled non-professionals, and plant enthusiasts to demonstrate their competency in and be acknowledged for their botanical skills (see Section 1-*Need For a Statewide Native Plant Conservation Strategy*, #2). A botanical certification program:

   a. would promote and encourage professional development, growth, and renewal through continual education while maintaining high standards of performance, particularly for people whose work requires plant identification, plant monitoring, wetland delineation, revegetation, etc.

   b. could be developed and offered by a non-profit organization, such as the Montana Native Plant Society, or by any federal or state agency.

   c. could address specific components of botany: plant identification/taxonomy, plant monitoring, seed collection, developing seed mixes, revegetation, or other learned skills and knowledge.

   d. should be modelled after existing programs, such as:

      - Certified Lichenologist for Macrolichens of the Pacific Northwest, Northwest Lichenologist[30]
      - Pollinator Steward Certification[31]
      - Certified in Wetland Delineation, Wetland Training Institute[32]
      - Field/Consulting Certified Botanist, California Native Plant Society[33]
      - Associate/Certified Wildlife Biologist, The Wildlife Society[34]

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[30] Northwest Lichenologists' Certification: https://northwest-lichenologists.wildapricot.org/page-1854204

[31] Pollinator Steward Certification: https://www.pollinator.org/psc

[32] Wetland Training Institute: https://wetlandtraining.com/

[33] Field/Consulting Certified Botanist: https://www.cnps.org/education/botanist-certification

[34] The Wildlife Society: https://wildlife.org/

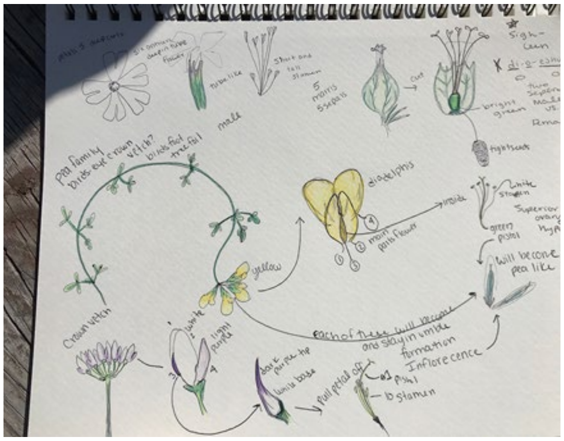
- Professional Brewer Certificate, State of Montana's Registered Apprenticeship Program[35]. This program collaborates with employer sponsors, employer associations, and labor/ management groups, and includes technical classroom instruction and on-the-job training.

3) Convene a panel of educators and botanists to develop plant-based curricula that also meet grade-level criteria for primary and secondary education. Curricula that incorporate grade-level teaching requirements are more likely to be used by educators and can bring plant awareness to students earlier. Plant-focused curricula could be merged with other topics, such as art, pollinators, fungi, air quality, and habitat (ecology).

4) Bring native plant-focused projects to youth- and adult-based programs that aim to build skills in the natural science and environmental fields; provide continuing education credit for teachers. Professional botanists and skilled laypeople could teach, lead, or create plant-focused activities and projects, and provide volunteer or internship opportunities. Youth- and adult-based programs that conduct botanical work in Montana include, but are not limited to:

- Youth Employment Program, Dillon, Montana and Salmon, Idaho[36]
- Americorps State Programs in Montana[37]
- Montana Conservation Corps (MCC)[38]
- Mission Mountains Youth Crew Program[39]
- Pull Your Share movement[40]
- Montana-based Master Naturalist Programs:
  - Montana Natural History Center, Missoula[41]
  - Montana Audubon Center, Billings[42]
  - Swan Valley Connections, Condon[43]
  - Montana Discovery Foundation, Helena[44]

5) Help bring native plant-focused educational programs and presentations to established nature-based educational centers. This support can elevate awareness of our connection with


Short and tall stamen
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Superior ovary
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will become pea like
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each of these will become and stay in umble formation
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Photo Credit: Robyn Klein

Photo 3-7. Botanical field sketches are a useful tool for training observation skills and learning plant identification.

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[35] State of Montana Registered Apprenticeship Program: https://apprenticeship.mt.gov/

[36] Youth Employment Program: https://www.youthemploymentprogram.org/

[37] Americorps State Programs in Montana: https://serve.mt.gov/americorps/ameriCorps-programs

[38] Montana Conservation Corps: https://www.mtcorps.org/

[39] Mission Mountains Youth Crew: https://www.nationalforests.org/regional-programs/northern-rockies/mission-mountains-youth-crew-program

[40] Pull Your Share Movement: https://www.pullyourshare.com/

[41] Montana Natural History Center: https://www.montananaturalist.org/

[42] Montana Aububon Center: https://mtaudubon.org/center/

[43] Swan Valley Connections: https://www.swanvalleyconnections.org/

[44] Montana Discovery Foundation: http://www.montanadiscoveryfoundation.org/

plants, incite curiosity, and help build a multi-generational workforce of botanists, ecologists, and others. Montana-based nature-centric educational organizations include, but are not limited to:

- Montana Native Plant Society[45]
- Helena-Lewis and Clark National Forest, Montana Discovery Foundation[44]
  - Celebrating Wildflowers[44A]
  - Adopt-A-Species Program[44B]
  - Plant-based public outdoor activities
- Montana WILD[46]
- Montana Natural History Center[41]

6) Garner agency support and funding for a Montana Fish Wildlife & Parks staff position to return "Discover Ecosystems" to the MFWP website or develop a similar program. This program provides foundational material for teaching about habitats; it addresses plants, animals, and abiotic components, and was heavily used by primary and secondary educators.

7) Become a supporting member of a plant-focused non-profit, such as the:

- Montana Native Plant Society[45]
- Plant Conservation Alliance[47]

8) Establish or collaborate with another organization to establish a plant conservation award and process for recognizing and/or rewarding landowners, land managers, and individuals for good stewardship of Plant Species, Unique Habitats, and Plant Communities of GCN. The recognition process could be developed, and the award presented by an agency or NGO. Programs that have developed conservation awards include, but are not limited to:

- The Montana Watershed Coordination Council
- Montana Wetland Council

9) Partner with non-native plant-focused groups and develop or share educational materials that address topics that promote native plants over invasive species. Refer also to Section 4, Protection and Restoration Conservation Objectives #5. Topics include, but are not limited to:

- Native plants to plant and what not to plant
- Integrated Weed Management techniques that are ecologically based, effective revegetation techniques and prescriptions
- Noxious weed identification and management

10) Participate in Montana Noxious Weed Awareness Week, held annually during the first full week of June. Signed into Montana law in 2021, this official week provides opportunities to promote native plants and educate on the negative impacts of noxious and invasive plants.

[44A] Celebrating Wildflowers: https://www.montanadiscoveryfoundation.org/programs/celebrating-wildflowers/

[44B] Adopt-A-Species: https://www.montanadiscoveryfoundation.org/programs/adopt-a-species/

[45] Montana Native Plant Society: https://mtnativeplants.org/

[46] Montana WILD: https://fwp.mt.gov/education/montana-wild

[47] Plant Conservation Alliance: https://www.plantconservationalliance.org/welcome

Outreach and Education

11) Preserve and protect Traditional Knowledge sharing between generations, and the practices, observations, methods, and technologies held by Indigenous peoples for conserving and enhancing native plant diversity and cultural preservation.

12) Extend invitations to members of Tribal Nations in Montana to engage in conversations, listen to their knowledge, and hear their concerns and needs regarding native plants, including Plant Species, Habitats, and Plant Communities of GCN.

Policy and Regulation

Conservation Goal

Improve citizen participation and amplify the voice for botanical issues in federal, state, and local project and planning efforts and support efforts that strengthen native plant conservation.

Conservation Objectives

1) Contact specific federal, state, county, and city agencies and find out the best ways to comment on proposed projects and planning efforts. Review and comment on issues related to the biodiversity and health of native plants, native plant communities, and Plant Species of GCN, Unique Habitats of GCN, and Plant Communities of GCN.

2) Support federal and state legislative efforts to fund or hire botanists and habitat biologists at a livable wage in the federal, state, and private sectors. For example, the Botanical Sciences and Native Plant Materials Research, Restoration, and Promotion Act [The Botany Bill] introduced to Congress in 2018 included mandates for hiring botanists at the federal level.

3) Adhere to State of Montana laws governing the regulation of wildcrafting [MCA-76-10][48]. This law governs the collection, harvesting, and removal of uncultivated plants and plant parts for the purpose of selling, trading, or exchanging the material for profit. The purpose is to encourage the growth of a statewide wildcrafting industry that encourages stewardship of wild plant natural resources [MCA 76-10-101]. The law requires a written permission or permit to wildcraft from the property from which the material is wildcrafted and specifies those requirements [MCA 76-10-103], definitions [MCA 76-10-103], and violations/penalties [MCA 76-10-107]. The law also invites tribes to enter into state-tribal cooperative agreements with Montana to provide for broader implementation.

4) Acknowledge and adhere to Tribal laws, ordinances, regulations, and policies, and protect Traditional Knowledge of plants as the intellectual property of Tribal Nations and individual Tribal members, including seeds, propagules and other plant parts occurring on Tribal jurisdictional lands.

5) Adhere to all federal regulations, permitting requirements, and harvesting prohibitions that govern the collection, harvesting, and removal of native plant materials (sometimes

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[48] MCA-77-10: https://leg.mt.gov/bills/mca/title_0760/chapter_0100/part_0010/sections_index.html

referred to as special forest products). Recognize that each national forest, field office, national wildlife refuge, and other jurisdictional units may have different guidelines, regulations, and permitting processes for managing native plant species and materials.

6) Back state legislation that supports Montana native plants or educates about the threats posed by noxious weeds. Examples of relevant legislation in Montana include, but are not limited to:
   - Montana House Bill 410, introduced in 2021, would have provided state guidance to seed or plant native plants friendly to animal pollinators.
   - Montana House Judiciary Bill 17, signed into law in 2021, establishes the first full week of June each year as Montana Noxious Weed Awareness Week.
7) Through the US Forest Service's Celebrating Wildflowers Program[49], strengthen collaboration with partnering agencies (BLM, USFWS, and NRCS) to increase activities about Montana's rare plants, and help keep information on USFS Region 1 rare plants current.
8) Review and consider providing support for the five-year renewals of the national Farm Bill[50], a package of legislation that has included conservation incentive programs for landowners, such as the Conservation Stewardship Program (CSP), Environmental Quality Incentives Program (EQIP), and Agricultural Conservation Easement Program (ACEP). Actions to protect grasslands that could aid Species and Plant Communities of GCN (WWF 2023) include:
   a. Expand and strengthen the Sodsaver provision in the Farm Bill. This provision reduces incentives to convert native sod to cropland. It could be strengthened by making newly cultivated native sod acreage ineligible for any crop insurance premium subsidy, and by tracking conversion to analyze the effects of Sodsaver.
   b. Bolster Grassland Conservation Reserve Program (CRP). This program pays farmers to remove environmentally sensitive land from agricultural production and to plant species that will improve environmental health and quality. This program could be improved by creating incentives to use native plant species and sustainable grazing practices.
   c. Bolster EQIP. This program provides financial and technical assistance to farmers and ranchers to address natural resource concerns and provide environmental benefits. This program could be improved by creating incentives to use native plant species and sustainable grazing practices.
   d. Support Tribal Nations in having equitable access to Farm Bill programs to support grassland conservation and management.
9) Join the Montana Native Plant Society's Conservation Committee[51]. This non-political committee considers public policy issues and communicates concerns and recommendations on native plants to the appropriate agency.

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[49] USFS Celebrating Wildflower Program: https://www.fs.usda.gov/managing-land/wildflowers

[50] National Sustainable Agriculture Coalition: https://sustainableagriculture.net/our-work/campaigns/fbcampaign/what-is-the-farm-bill/

[51] MNPS Conservation Committee: https://mtnativeplants.org/conservation-issues/

REFERENCES

Bahls, Loren. 2021-23. *Diatoms of Montana and Western North America: Catalog and Atlas of Species in the Montana Diatom Collection*. 2 vols. The Academy of Natural Sciences of Philadelphia.

Booth, William E. 1950. *Flora of Montana, Part I: Conifers and Monocots*. Bozeman, MT: The Research Foundation at Montana State College.

Booth, William E., and J.C. Wright. 1966. *Flora of Montana, Part II: Dicotyledons*. Bozeman, MT: Montana State University

Edmo, Termaine. 2024. Personal correspondence. Climate Change Coordinator. Blackfeet Environmental Office. Blackfeet Nation. Browning, MT.

Elliott, Joe C. 1993. Second checklist of Montana mosses (draft). Prepared for Montana Natural Heritage Program, Helena, Montana.

Elliott, Joe C., and Andrea Pipp. 2019. "History, biogeography, and species of Montana mosses (1880-2018)." Evansia 36(2): 39-58. https://doi.org/10.1639/0747-9859-36.2.39

Elliott, Joe C., and Andrea Pipp. 2020. *A Checklist of Montana Mosses* (1880-2018). Helena, MT: Montana Natural Heritage Program. https://archive.org/details/AchecklistofMon50/mode/2up

Elzinga, Caryl L., Daniel W. Salzer, and John W. Willoughby. 1998. Measuring and Monitoring Plant Populations. BLM Technical Reference 1730-1. Bureau of Land Management, National Business Center, Denver, CO. https://www.ntc.blm.gov/krc/system/files/legacy/uploads/3342/technical%20reference.pdf

Gopher, Keith. 2024. Personal Communication. Water Quality Manager and Former Wetlands Manager, Water Resources Office, Chippewa-Cree of the Rocky Boy Tribe, Box Elder, MT.

Grant, Emerald. 2024. Personal Communication. Wetlands Manager, Blackfeet Environmental Office, Blackfeet Nation, Browning, MT.

Hong, W.S. 2002. "A key to the *Hepaticae* of Montana." Northwest Science 76(4): 271-85.

Kramer, A.T., B. Zorn-Arnold, and K. Havens. 2010. Assessing botanical capacity to address grand challenges in the United States. 64 pp. plus appendices. https://www.bgci.org/wp/wp-content/uploads/2019/06/US-Botanical-Capacity-Report.pdf [Accessed February 2024]

Kramr, Andrea T., Barbara Zorn-Arnold, and Kayri Havens. 2013. "Applying lessons from the U.S. Botanical Capacity Assessment Project to achieve 2020 Global Strategy for Plant Conservation targets." *Annals of the Missouri Botanical Garden*. 99(2): 172-79.

Lesica, Peter, Matt T. Lavin, and Peter F. Stickney. 2022. *Manual of Montana Vascular Plants*, 2nd Edition. Fort Worth, TX: BRIT Press.

Lesica, Peter, Matt T. Lavin, and Peter F. Stickney. 2012. *Manual of Montana Vascular Plants*. Fort Worth, TX: BRIT Press.

Longknife Jr, Dennis. 2024. Personal Communication. Climate Change Coordinator, Fort Belknap Indian Community, Harlem, MT.

Luna, Tara, Pauline Matt, and Keith Gopher. 2017. The Circle of Seasons: Plants are Life and Montana's First Botanists. In: Montana's Pioneer Botanists, Exploring the Mountains and Prairies. Potter, Rachel and Peter Lesica (eds.). Montana Native Plant Society, Missoula, MT.

Majerus, Mark. 2022. Germination of Wildland Collected Seed. Montana Native Plant Society, Landscape and Revegetation Committee, Missoula, MT. https://mtnativeplants.org/wp-content/uploads/2022/03/MNPS-Wild-Seed-Germination-Paper-draft.pdf

McCune, Bruce, Roger Rosentreter, Toby Spribille, Othmar Breuss, and Tim Wheeler. 2014. *Montana Lichens: An Annotated List*. Corvallis, OR: Northwest Lichenologists.

Montana Native Plant Society (MNPS). No Date (ND). Plant Collection Guidelines for Teachers. Missoula, MT. https://mtnativeplants.org/wp-content/uploads/2018/07/MNPS-Plant-Collection-Guidelines-for-Teachers.pdf [2023 May 15]

Montana Native Plant Society (MNPS). 2003. Guidelines for Collecting Native Plants. Missoula, MT. https://mtnativeplants.org/wp-content/uploads/2018/07/MNPS-Guidelines-for-Collecting-Native-Plants-.pdf [2023 May 15]

Montana Native Plant Society (MNPS). 2024. Montana Native Plant Source Guide. April 4. Missoula, MT. https://mtnativeplants.org/wp-content/uploads/2024/04/Native-Plant-Sourceguide.pdf [2024 April 15]

Montana Natural Heritage Program (MTNHP). 2024. Montana Field Guide for Fungi. Checklist developed by Tim Wheeler and Cathy Cripps. Helena, MT: MTNHP. https://fieldguide.mt.gov/displayPhyDiv.aspx?Kingdom=Fungi

Montana State Historical Preservation Office (Montana SHPO). 2023. The Montana Historic Preservation Plan, 2023-2027: Past, Present, and Future. January. Montana Historical Society, Helena, MT. https://mhs.mt.gov/Shpo/docs/MontanaStatePlan_2023_2027.pdf

Nisbet, Jack. 2017. Introduction. In: Montana's Pioneer Botanists, Exploring the Mountains and Prairies. Potter, Rachel and Peter Lesica (eds.). Montana Native Plant Society, Missoula, MT.

Noss, Reed R., and Allen Y. Cooperrider. 1994. Saving Nature's Legacy, Protecting and Restoring Biodiversity. Island Press, Washington D.C.

Potter, Rachel and Peter Lesica (eds.). 2017. Montana's Pioneer Botanists, Exploring the Mountains and Prairies. Montana Native Plant Society, Missoula, MT.

Prescott, G.W., and G.E. Dillard. 1979. *A Checklist of Algal Species Reported from Montana, 1891 to 1977.* Monograph number 1. Supplement to the Proceedings. Vol. 38. Montana Academy of Sciences.

Shanley, James. 2006. Montana Tribal Colleges: History, Mission, and Promise. The Montana Professor, 162. Spring. https://mtprof.msun.edu/Spr2006/shan.html [Accessed 6 March 2024].

Whyte, Kyle, S. Gaughen, H Hardison, C. Jones, D. Marks-Marino, G. Morishima, H. Mullen, and A. Walker, (2021). Worldviews, Knowledges, and Social Impacts. In *Status of Tribes and Climate Change Report* [Marks-Marino, D. (ed.)]. Institute for Tribal Environmental Professionals, pp. 34–45.

World Wildlife Fund (WWF). 2023. Plowprint. https://files.worldwildlife.org/wwfcmsprod/files/Publication/file/6wlbsmxokc_PlowprintReport_2023_final.pdf?_ga=2.40396642.1303365568.1711488292-508164714.1711488292 [Accessed 26 March 2024]

SECTION 4

Vascular Plant Species of Greatest Conservation Need

SECTION 4

MONTANA'S VASCULAR PLANTS OF GREATEST CONSERVATION NEED

MONTANA'S FLORA

Montana is the fourth-largest state in the United States (US), and it encompasses great diversity in its native landscapes, species, and habitats. Mountains define the central and western Rocky Mountain region while grasslands characterize the central and eastern Great Plains region of the state. Throughout are streams, lakes, and wetlands of numerous types. The large topographic relief creates a boreal influence at higher elevations, as well as precipitation patterns that differ in the lower elevations. Collectively, the topography, hydrology, geology, soils, and other factors create numerous habitats, home to a great diversity of species.

Montana's diverse vegetation is composed of 2,092 native[1] vascular plant species that historically or currently grow in the state (Lesica et al. 2022). This is comparable to or less than other western states but is at least 40% more than the midwestern states of North and South Dakota (NatureServe 2023). Another 442 exotic[2] vascular plant species reside in the state, having-arrived primarily through anthropogenic vectors (Lesica et al. 2022). Collectively, Montana is home to 2,833 vascular plant taxa (species, varieties, subspecies, and hybrids) (Lesica et al. 2022).

The distribution and population sizes of Montana's native plant species and prevalence of habitats vary greatly across the state. While most native plants are common or have secure populations, many others are considered rare across the globe or in our state. Whether locally abundant, widely scattered, or scarce, rare plants often exhibit small population sizes, narrow geographic ranges, affinities to unique habitats, and/or have low reproductive rates. Rare plants are often at risk of extirpation in the state, or even worldwide extinction, because of a lack of awareness about their precarious status. This fragile status may be due to biological factors, an inability to recover from catastrophic drought, fire, and/or anthropogenic threats. Rare plants contribute uniqueness to Montana's natural heritage, increasing biodiversity, and beautifying our landscapes; yet their vulnerability to environmental changes and increasing levels of human-caused threats requires special management and greater public awareness.

Like many rare species, some of Montana's common, even iconic, plants are also facing declines and becoming vulnerable to extirpation. In this section of the *Montana Native Plant Conservation Strategy*, we address plant species that are at risk of extirpation in the state and prioritize the plants that are in greatest need of conservation. We also provide information on their status, location, and associated habitats. We outline conservation objectives that, if implemented, would aid their persistence, and help strengthen botanical capacity[3] in Montana.

How Many Plants are At Risk in Montana?

The Montana Natural Heritage Program (MTNHP) is the state's source for information on the species, distribution, and status of our native and exotic flora [Montana Code Annotated (MCA) 90-15-301]. Currently, the MTNHP tracks 432 vascular plant species, varieties, and subspecies as being a Montana Species of Concern (SOC) or Potential Species of Concern (PSOC)[4] (MTNHP 2024a). The SOC and PSOC designations are based on the plant's conservation status rank, which reflects its level of risk to extinction or extirpation based on rarity (distribution, abundance, and occupied habitat), threats, population trends, and level of protection (Box 4-1). Montana SOC and PSOC have state conservation status ranks, hereafter referred to as a Subnational (S) or State (S) Rank, which ranges from "vulnerable" (S3), to "imperiled" (S2), to "critically imperiled" (S1) (Box 4-1). Many of the Montana SOC and PSOC plants also have federal agency designations, but no additional state agency designations. The State-Rank (S-Rank) carries no statutory or regulatory classification.

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[1] Native vascular plants are those that were known to occur in Montana before European settlement, typically dated as prior to or during the Lewis and Clark Expedition from 1803 to 1806.

[2] Exotic plant species are also referred to as non-native or introduced.

[3] Refer to Section 3, page 2 for definition.

Photo Credit: Bruce Selyem

*Photo 4-1. Dwarf Purple Monkeyflower (*Mimulus nanus*) grows in vernally moist, sandy soils on open slopes in southwest Montana.*

Photo Credit: Bruce Selyem

*Photo 4-2. Clustered Lady's-Slipper (*Cypripedium fasciculatum*) grows in warm, dry mid-seral forests dominated by Douglas-fir (*Pseudotsuga menziesii*) trees in northwest Montana.*

Box 4-1. Global and state conservation status definitions for ranking plant species and ecosystems by the Montana Natural Heritage Program (2024a and 2024c) and NatureServe (2024).

GLOBAL (G) RANK	STATE (S) RANK	DEFINITION
G1	S1	**Critically Imperiled** - At very high risk of collapse or global extinction or state extirpation due to a very restricted range, very few populations or occurrences, very steep declines, severe threats, or other factors.
G2	S2	**Imperiled** - At high risk of collapse or global extinction or state extirpation due to a restricted range, few populations or occurrences, steep declines, severe threats, or other factors
G3	S3	**Vulnerable** - At moderate risk of collapse or global extinction or state extirpation due to a fairly restricted range, few populations or occurrences, recent and widespread declines, threats, or other factors.
G4	S4	**Apparently Secure** - At a fairly low risk of collapse or global extinction or state extirpation due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats, or other factors.
G5	S5	**Secure** - At very low or no risk of collapse or global extinction or state extirpation due to a very extensive range, abundance populations or occurrences, with little to no concern from declines or threats.

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[4] Refer also to Section 1, Box 1-3. Species of Concern (SOC) are native taxa that are at-risk due to declining population trends, threats to their habitats, a restricted distribution, and/or other factors. Potential Species of Concern (PSOC) are native taxa for which current, often limited, information suggests a potential for vulnerability to extirpation in the state.

Determining Plant Species of Greatest Conservation Need

A large partnership of botanists, biologists, and ecologists working for or retired from federal and state land management agencies, non-governmental organizations (NGOs), and academia met on April 26, 2019 to discuss the concept of a Montana Rare Plant Conservation Strategy[5]. The discussions surfaced concerns for common tree and shrub species facing potential decline in addition to rare plants and habitats. It was largely agreed upon that a voluntary, non-regulatory approach could aid efforts to conserve certain plant species and habitats. What transpired was the development of a Montana Native Plant Conservation Strategy and the formation of a Criteria-Species-Habitat Subcommittee (Montana Native Plant Conservation Strategy-Criteria, Species, and Habitats Subcommittee 2021).

Photo Credit: Matthew Stewart, 406 Stewart Photography

*Photo 4-3. Lesser Rushy Milkvetch (*Astragalus convallarius*) is known from two disjunct localities in southwest Montana - where it grows in grasslands and Ponderosa Pine (*Pinus ponderosa*) woodlands.*

A subcommittee determined what would constitute a species, unique habitat, and plant community as being of "greatest conservation need". Information was compiled from MTNHP, federal, and state agency databases, literature, and professional expertise. Potential inclusion of a species was predominantly based on a systematic, scientific approach using centralized data, and mostly not on incorporating cultural information. The subcommittee formulated criteria and reviewed information on listed and recommended species to determine Plant Species of Greatest Conservation Need (Box 4-2). The subcommittee also determined that information on mosses and lichens, while available, was not centralized enough for determining a species of greatest conservation need. In addition, most agencies were not ready to address non-vascular species.

The subcommittee, with agreement by the larger partnership on April 12, 2021, proposed 129 plant species for inclusion in the *Montana Native Plant Conservation Strategy*, hereafter the *Strategy*. Further refinement of the Montana State Threat Score, input from

Box 4-2. Criteria used for determining a Plant Species of Greatest Conservation Need in Montana.

1) A Vascular Plant Species of Concern ranked as:
    - G1, G2, G3, or in combination, OR S1, S2, S3, or in combination, AND
    - Faces a direct or indirect threat as determined by the Montana State Threat Score, OR is associated with a Unique Habitat or Plant Community of GCN that faces a significant or highly probable threat, OR is poorly documented/information needed [PSGIN] AND
    - Lacks taxonomic problems OR large location ambiguity.
2) A vascular non-SOC plant that is nominated by several Strategy partners representing different organizations as being "of management concern" because the species is facing significant threats and potential decline.

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[5] This meeting laid the groundwork for planning and development of a *Montana Native Plant Conservation Strategy: Vascular Species and Habitats of Greatest Conservation Need*. Almost 35 organizations were invited; 22 people attended, representing retired and working professionals for federal and state government, NGOs, and academic herbaria organizations (see Table 1, page *iii*).

engaged *Strategy* partners, and a second round of data review honed the list, and the Strategy now identifies 109 vascular plants as Plant Species of Greatest Conservation Need (GCN). A subset of these plants are also categorized as a Plant Species of Greatest Inventory Need (PGSIN) because they are poorly documented and information is needed. It is likely that with more information, insight, and attention from the statewide botanical community the list of Plant Species of GCN will be revised in future versions of the *Strategy*.

MONTANA'S PLANT SPECIES OF GREATEST CONSERVATION NEED

The 109 Plant Species of GCN consist of 105 Montana SOC and 4 "of management concern" vascular plants of which many are also cultural plants (Tables 4-1 and 4-2). The 109 Plant Species of GCN are further divided into categories of priority. Priority 1 is assigned to 23 plant species for which there is more rigorous observation and mapping data, at least some monitoring or research data, and/or biological literature (Table 4-1). Because we know more about the Priority 1 species, it is possible for members of the botanical community to develop species-specific conservation profiles and conservation objectives/actions. Priority 2 is assigned to 86 plant species about which less is known beyond accurate observation data and, for some species, moderately precise mapping (Table 4-2). Priority 2 was also assigned to SOC plants that associate strongly with a Unique Habitat or Plant Community of GCN, in which conservation is focused more heavily on the habitat.

Many of the Plant Species of GCN have additional designations (Tables 4-1 and 4-2). Under the Endangered Species Act (ESA) of 1973, as amended, the US Fish and Wildlife Service (USFWS) shares responsibility in managing five Montana SOC plants: Spalding's Catchfly (*Silene spaldingii*), Ute ladies'-tresses (*Spiranthes diluvialis*), and Whitebark Pine (*Pinus albicaulis*) are federally-listed as Threatened (USFWS 1992, 2001, 2022); Water Howellia (*Howellia aquatilis*) was delisted in 2021 but is being tracked through the post-delisting monitoring plan (USFWS 2020); and Thick-leaf Bladderpod (*Physaria pachyphylla*) was petitioned for listing with the 12-month status review ongoing (USFWS 2021). Region 1 of the US Forest Service (USFS-Region 1) designates 52 Plant Species of GCN as Sensitive or Species of Conservation Concern. The Montana/Dakotas Bureau of Land Management (MT/Dakotas BLM) designates 17 Plant Species of GCN as Sensitive. Tribal Nations in Montana may also have designations for plant species that are culturally significant or locally rare on their Tribal lands; these plant species are protected through their own Tribal laws, regulations, ordinances, and land management policies. Federally recognized tribes that have a land-base, who have Tribal Historic Preservation Offices, may also protect culturally significant native plant species in their project work. There are no additional State of Montana agency designations, beyond SOC and PSOC, for the 109 Plant Species of GCN.

Photo Credit: Henry Hardin

*Photo 4-4. Populations of Short-spine Horsebrush (*Tetradymia spinosa*), a shrub, tend to be small and reproduction may be tied to precipitation patterns.*

Table 4-1. The 23 vascular Plant Species of Greatest Conservation Need in Montana categorized as Priority 1[a]. Information on their distribution, ranks, status, designations, threats, occurrences, and select reasons for inclusion as a GCN reflects data as of April 2024 (MTNHP 2024b).

MTNHP Primary Name *Scientific Name*[b] Common Name[c]	State Distribution Pattern[d]	Global Rank[e]	State Rank[f]	Montana State Status[g]	Federal Designations ESA[h] BLM[i] USFS[j]	Montana State Threat Score[k]	Climate Change Vulnerability Index[l]	Number of SOs[m]	Select Reasons for Being Plant Species of GCN[n]
Astragalus barrii Barr's Milkvetch	regional endemic	G3G4	S3	SOC		Medium - Low	Highly Vulnerable	187	Threat
Boechera fecunda Sapphire Rockcress	state endemic	G2	S2	SOC	**BLM:** Sensitive **USFS:** Sensitive- Known (BD, BRT); Sensitive-Suspected (LOLO)	Medium	Moderately Vulnerable	68	Threat; Metamorphosed Limestone GCN
Cirsium longistylum Long-styled Thistle	state endemic	G2G3	S2S3	SOC		Medium	Less Vulnerable	154	Threat
Cypripedium fasciculatum Clustered Lady's-slipper	scattered, peripheral	G4	S3	SOC	**USFS:** Sensitive- Known (KOOT, LOLO); Species of Conservation Concern (FLAT)	Medium	Moderately Vulnerable	113	Threat
Cypripedium passerinum Sparrow's-egg Lady's-slipper		G5	S2S3	SOC	**USFS:** Sensitive- Known (KOOT); Sensitive-Suspected (LOLO); Species of Conservation Concern (FLAT, HLC)	Low	Moderately Vulnerable	89	Peatland [Fen] GCN
Epipactis gigantea Giant Helleborine	scattered	G4	S5	SOC	**USFS:** Sensitive- Known (BD, BRT, KOOT, LOLO); Species of Conservation Concern (FLAT, HLC)	Low	Moderately Vulnerable	46	Peatland [Fen] GCN
Fraxinus pennsylvanica Green Ash		G4	S5	management concern					Significant Potential Threat; Of Management Concern
Goodyera repens Northern Rattlesnake-plantain		G5	S3	SOC	**USFS**: Species of Conservation Concern (HLC)	High - Low	Moderately Vulnerable	244	Threat

Table 4-1. [continued from page 6] The 23 vascular Plant Species of Greatest Conservation Need in Montana categorized as Priority 1[a]. Information on their distribution, ranks, status, designations, threats, occurrences, and select reasons for inclusion as a GCN reflects data as of April 2024 (MTNHP 2024b).

MTNHP Primary Name *Scientific Name*[b] Common Name[c]	State Distribution Pattern[d]	Global Rank[e]	State Rank[f]	Montana State Status[g]	Federal Designations ESA[h] BLM[i] USFS[j]	Montana State Threat Score[k]	Climate Change Vulnerability Index[l]	Number of SOs[m]	Select Reasons for Being Plant Species of GCN[n]
Grindelia howellii Howell's Gumweed	regional endemic	G3	S2S3		**BLM:** Sensitive **USFS:** Sensitive- Known (LOLO); Sensitive-Suspected (KOOT); Species of Conservation Concern (FLAT, HLC)	High - Medium	Less Vulnerable	187	Threat
Howellia aquatilis Water Howellia	disjunct, scattered	*G3*	S3	SOC	**ESA:** DM	High - Medium	Extremely Vulnerable	232	Threat; Wooded Vernal Pools GCN
Penstemon lemhiensis Lemhi Beardtongue	regional endemic	*G3*	S3	SOC	**BLM:** Sensitive **USFS:** Sensitive- Known (BD, BRT)	High - Medium	Moderately Vulnerable	427	Threat
Phlox missoulensis Missoula Phlox	state endemic	*G3*	S3	SOC	**USFS:** Sensitive- Known (BD); Sensitive-Suspected (LOLO); Species of Conservation Concern (HLC)	*to be assessed*	Highly Vulnerable	6	Threat
Physaria didymocarpa* var. *lanata Woolly Twinpod		*G5T2*	S2S3	SOC	**USFS:** Species of Conservation Concern (CG)	No Known Threat		10	Threat
Physaria douglasii Douglas Bladderpod	peripheral	*G5*	S1	SOC	**USFS:** Sensitive-Known (KOOT)	Medium	Extremely Vulnerable	8	Threat
Physaria pachyphylla Thick-leaf Bladderpod	regional endemic	*G2G3*	S2S3	SOC	**ESA:** Petitioned **BLM:** Sensitive	Low	Moderately Vulnerable	16	Threat
Pinus albicaulis Whitebark Pine	widespread	*G3G4*	S3	SOC	**ESA:** LT **BLM/USFS:** Threatened	*to be assessed*	Highly Vulnerable	5799	Threat; Trend?
Pinus monticola Western White Pine	peripheral	*G4G5*	S3S4	management concern		*to be assessed*			Threat; Trend?; Of Management Concern

Table 4-1. [continued from page 7] The 23 vascular Plant Species of Greatest Conservation Need in Montana categorized as Priority 1[a]. Information on their distribution, ranks, status, designations, threats, occurrences, and select reasons for inclusion as a GCN reflects data as of April 2024 (MTNHP 2024b).

MTNHP Primary Name *Scientific Name*[b] Common Name[c]	State Distribution Pattern[d]	Global Rank[e]	State Rank[f]	Montana State Status[g]	Federal Designations ESA[h] BLM[i] USFS[j]	Montana State Threat Score[k]	Climate Change Vulnerability Index[l]	Number of SOs[m]	Select Reasons for Being Plant Species of GCN[n]
Populus tremuloides Quaking Aspen		*G5*	S5	management concern					Threat; Trend?; Of Management Concern; Of Cultural Importance
Primula alcalina Alkali Primrose	scattered	*G2*	S2	SOC	**BLM:** Sensitive **USFS:** Sensitive-Known (BD)	Very High	Extremely Vulnerable	19	Threat
Primula incana Mealy Primrose	scattered	*G5*	S3	SOC		High	Highly Vulnerable	78	Threat
Quercus macrocarpa Bur Oak	peripheral	*G5*	S2	SOC		High	Highly Vulnerable	11	Threat; Bentonite Deposits GCN
Silene spaldingii Spalding's Catchfly	scattered	*G2*	S2	SOC	**ESA:** LT **BLM/USFS:** Threatened	Very High	Extremely Vulnerable	75	Threat
Spiranthes diluvialis Ute Ladies'-tresses	scattered; US endemic	*G2G3*	S1S2	SOC	**ESA:** LT **BLM/USFS:** Threatened	High	Extremely Vulnerable	29	Threat

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[a] Strategy Priority: Priority 1 species have more rigorous observation and mapping data, at least some monitoring or research, and/or biological literature. Less is known about Priority 2 plant species - beyond accurate observation data and, for some species, moderately precise mapping.

[b] Scientific Name used as the primary name in the MTNHP botany database (MTNHP 2024b).

[c] Common Name used as the primary name in the MTNHP botany database (MTNHP 2024b).

[d] Distributional pattern of the plant in Montana based on literature (Lesica 2022) and botanical expertise.

[e] Global Rank as determined by NatureServe (2024). Refer to Box 4-1 and NatureServe Explorer: https://explorer.natureserve.org/

[f] State Rank as determined by MTNHP (2024b). Refer to Box 4-1 and MTNHP Montana Field Guide: https://fieldguide.mt.gov/default.aspx

[g] Montana Status: State-level designation (MTNHP 2024b) or other "of concern" notation.

[h] US Fish and Wildlife Service's designation under the Endangered Species Act (MTNHP 2024b).

[i] Montana/Dakotas Bureau of Land Management (BLM) designation (MTNHP 2024b).

[j] Region 1, US Forest Service (USFS) designation by forest (MTNHP 2024b).

[k] Montana State Threat Score (MTNHP Threat Assessment 2021).

[l] Climate Change Vulnerability Index score. See Box 4-5 for definitions (MTNHP 2021).

[m] Number of Species Occurrences (extant, extirpated, and historical) mapped by MTNHP as of March 2024 (MTNHP 2024b). NA means "not applicable".

[n] A selection of abbreviated reasons for being a Plant Species of Greatest Conservation Need (GCN) and Plant Species of Greatest Inventory Need (SPGIN).

Table 4-2. The 86 vascular Plant Species of Greatest Conservation Need in Montana categorized as Priority 2a. Information on their distribution, ranks, status, designations, threats, occurrences, and select reasons for inclusion as a GCN reflects data as of April 2024 (MTNHP 2024b).

MTNHP Primary Name *Scientific Name*[b] Common Name[c]	State Distribution Pattern[d]	Global Rank[e]	State Rank[f]	Montana State Status[g]	Federal Designations ESA[h] BLM[i] USFS[j]	Montana State Threat Score[k]	Climate Change Vulnerability Index[l]	Number of SOs[m]	Select Reasons for Being Plant Species of GCN[n]
***Agastache cusickii* Cusick's Horsemint**	scattered or peripheral	*G3G4*	S2S3	SOC	**BLM:** Sensitive **USFS:** Sensitive-Known (BD)	High - Medium	Moderately Vulnerable	9	Threat
Allium columbianum Columbia Onion	scattered	*G3*	S1	SOC	**USFS:** Sensitive-Known (BD)	Medium	Highly Vulnerable	12	Bedrock Glades GCN
Allium parvum Small Onion	scattered	*G5*	S2S3	SOC	**USFS:** Sensitive-Known (BRT); Sensitive-Suspected (BD)	Very High - High	Less Vulnerable	174	Threat; Trend
Alnus rubra Red Alder	disjunct	*G5*	S2S3	SOC		No Known Threat		9	Information Needs (PSGIN)
Ammannia robusta Scarlet Ammannia	scattered, disjunct	*G5*	S2	SOC		Medium	Moderately Vulnerable	7	Threat; Poorly Documented (PSGIN)
Anthoxanthum hirtum Northern Sweet Grass		*G5*	S3S4	management concern					Threat; Trend; Of Cultural Importance
Astragalus ceramicus* var. *apus Painted Milkvetch		*G4T3*	S1S2		**BLM:** Sensitive	Medium - Low	Extremely Vulnerable	2	Centennial Valley Sand Dunes GCN; Threat
Astragalus convallarius Lesser Rushy Milkvetch	disjunct	*G5*	S3	SOC	**USFS:** Species of Conservation Concern (HLC)	Medium - Low	Moderately Vulnerable	76	Western (Montane) Grasslands GCN
Astragalus oreganus Wind River Milkvetch		*G4?*	S2	SOC		Medium	Moderately Vulnerable	8	Threat
Athysanus pusillus Sandweed	peripheral	*G5*	S1S2	SOC	**USFS:** Sensitive-Known (BRT, KOOT); Sensitive-Suspected (LOLO)	High	Highly Vulnerable	24	Threat
Braya humilis Low Braya		*G5*	S2	SOC	**USFS:** Sensitive-Known (BD); Species of Conservation Concern (HLC)	Unknown?	Highly Vulnerable	7	Threat (CCVI); Trend?; Information Needs (PSGIN)

Table 4-2. [continued from page 9] The 86 vascular Plant Species of Greatest Conservation Need in Montana categorized as Priority 2a. Information on their distribution, ranks, status, designations, threats, occurrences, and select reasons for inclusion as a GCN reflects data as of April 2024 (MTNHP 2024b).

MTNHP Primary Name *Scientific Name*[b] Common Name[c]	State Distribution Pattern[d]	Global Rank[e]	State Rank[f]	Montana State Status[g]	Federal Designations ESA[h] BLM[i] USFS[j]	Montana State Threat Score[k]	Climate Change Vulnerability Index[l]	Number of SOs[m]	Select Reasons for Being Plant Species of GCN[n]
Calochortus bruneaunis Bruneau Mariposa Lily	peripheral	G5	S2	SOC		Low	Highly Vulnerable	6	Threat; Sagebrush Communites GCN
Carex gravida Heavy Sedge	scattered	G5	S3	SOC	**USFS:** Species of Conservation Concern (CG)	High - Medium	Moderately Vulnerable	39	Threat
Carex idahoa Idaho Sedge	scattered and peripheral	G3	S3	SOC	**BLM:** Sensitive **USFS:** Sensitive-Known (BD)	High	Highly Vulnerable	59	Threat
Carex sychnocephala Many-headed Sedge	extant?	G5	S1S2	SOC		High - Medium		9	Threat
Castilleja covilleana Coville Indian Paintbrush		G3G4	S3		**USFS:** Sensitive-Known (BD, BRT); Sensitive-Suspected (KOOT)	Low	Moderately Vulnerable	115	Trend? (PSGIN)
Clarkia rhomboidea Diamond Clarkia	peripheral	G5	S3	SOC	**USFS:** Sensitive-Known (LOLO)	Low	Less Vulnerable	55	Threat? (PSGIN)
Cleome lutea Yellow Beeplant		G5	S1S2	SOC		No Known Threat?		14	Poorly Documented (PSGIN); Threat (lack of disturbance)?
Cryptantha fendleri Fendler Cat's-ey	scattered	G5	S2	SOC	**BLM:** Sensitive	Medium	Extremely Vulnerable	40	Centennial Valley Sand Dunes GCN; Threat
Cyperus schweinitzii Schweinitz's Flatsedge	scattered and peripheral	G5	S2	SOC		Low		19	Other Sandy Habitats GCN
Dichanthelium acuminatum Panic Grass	scattered	G5	S2S3	SOC		Unknown		14	Hot Springs (Sensitive Area, not GCN)

Table 4-2. [continued from page 10] The 86 vascular Plant Species of Greatest Conservation Need in Montana categorized as Priority 2a. Information on their distribution, ranks, status, designations, threats, occurrences, and select reasons for inclusion as a GCN reflects data as of April 2024 (MTNHP 2024b).

MTNHP Primary Name *Scientific Name*[b] Common Name[c]	State Distribution Pattern[d]	Global Rank[e]	State Rank[f]	Montana State Status[g]	Federal Designations ESA[h] BLM[i] USFS[j]	Montana State Threat Score[k]	Climate Change Vulnerability Index[l]	Number of SOs[m]	Select Reasons for Being Plant Species of GCN[n]
Dichanthelium oligosanthes* var. *scribnerianum Scribner's Panic Grass	scattered	G5T5	S1S2	SOC		Low		10	Poorly Documented (PSGIN)
Draba densifolia Dense-leaf Draba	scattered	G5	S3	SOC	**USFS:** Sensitive-Known (BD, BRT); Species of Conservation Concern (CG, HLC)	Low	Moderately Vulnerable	35	Threat
Drosera anglica English Sundew		G5	S3	SOC	**USFS:** Sensitive-Known (BD, BRT, KOOT, LOLO); Species of Conservation Concern (CG, HLC)	Low	Highly Vulnerable	55	Threat; Peatland [Fen] GCN
Drosera linearis Slenderleaf Sundew		G4G5	S2	SOC	**USFS:** Species of Conservation Concern (FLAT, HLC)	Unknown	Extremely Vulnerable	7	Peatland [Fen] GCN
Eleocharis bella Delicate Spikerush		G5	S1	SOC				7	Poorly Documented (PSGIN)
Eleocharis rostellata Beaked Spikerush	scattered	G5	S3	SOC	**USFS:** Species of Conservation Concern (CG, FLAT, HLC)	Unknown	Less Vulnerable	28	Hot Springs (Sensitive Area, not GCN)
Elymus flavescens Sand Wildrye	peripheral	G3	S1S2	SOC	**BLM:** Sensitive	Low	Extremely Vulnerable	4	Centennial Valley Sand Dunes GCN; Threat
Erigeron leiomerus Smooth Fleabane		G4	S2	SOC		Low	Extremely Vulnerable	5	Threat; Information Needs (PSGIN)
Erigeron linearis Linear-leaf Fleabane	peripheral	G5	S2	SOC		Low	Less Vulnerable	75	Threat
Eriogonum salsuginosum Smooth Buckwheat	peripheral	G4?	S1S2	SOC		Unknown	Moderately Vulnerable	4	Information Needs (PSGIN)

Table 4-2. [continued from page 11] The 86 vascular Plant Species of Greatest Conservation Need in Montana categorized as Priority 2a. Information on their distribution, ranks, status, designations, threats, occurrences, and select reasons for inclusion as a GCN reflects data as of April 2024 (MTNHP 2024b).

MTNHP Primary Name *Scientific Name*[b] Common Name[c]	State Distribution Pattern[d]	Global Rank[e]	State Rank[f]	Montana State Status[g]	Federal Designations ESA[h] BLM[i] USFS[j]	Montana State Threat Score[k]	Climate Change Vulnerability Index[l]	Number of SOs[m]	Select Reasons for Being Plant Species of GCN[n]
Eriogonum soliceps Railroad Canyon Wild Buckwheat		G3	S3	SOC	**BLM:** Sensitive	No Known Threat	Less Vulnerable	25	Information Needs (PSGIN)
Githopsis specularioides Common Blue-cup	disjunct?	G5	S1S2	SOC	**USFS:** Sensitive-Known (KOOT)	No Known Threat?		1	Vernally Moist Cliffs GCN; Information Needs (PSGIN)
Glossopetalon spinescens Spiny Greasebush		G5	S1	SOC	**USFS:** Sensitive-Known (BRT)	Unknown?		1	Threat?; Information Needs (PSGIN)
Grayia spinosa Spiny Hopsage	peripheral	G5	S2	SOC	**USFS:** Species of Conservation Concern (CG)	Unknown	Less Vulnerable	28	Threat?; Information Needs (PSGIN)
Heterocodon rariflorum Western Pearl-flower		G5	S2	SOC	**USFS:** Sensitive-Known (BRT, KOOT, LOLO)	Medium - Low	Moderately Vulnerable	59	Threat; Vernally Moist Cliffs GCN
Idahoa scapigera Scalepod	peripheral	G5	S1S2	SOC	**USFS:** Sensitive-Known (BRT); Sensitive-Suspected (LOLO); Species of Conservation Concern(FLAT)	High - Medium	Moderately Vulnerable	18	Threat; Bedrock Glades GCN
Ipomopsis congesta ssp. crebrifolia Ballhead Ipomopsis		G5T3 T4	S2S3	S2S3		No Known Threat		19	Sagebrush Communities GCN
Kochia americana Red Sage	peripheral	G5	S2	SOC		Unknown?	Moderately Vulnerable	5	Information Needs (PSGIN)
Lagophylla ramosissima Slender Hareleaf	disjunct	G5	S1	SOC		LOw		12	Poorly Documented (PSGIN); Threat
Lemna valdiviana Pale Duckweed	peripheral	G5	S1	SOC		Unknown		4	Warm Springs (Sensitive Area, not GCN)

Table 4-2. [continued from page 12] The 86 vascular Plant Species of Greatest Conservation Need in Montana categorized as Priority 2a. Information on their distribution, ranks, status, designations, threats, occurrences, and select reasons for inclusion as a GCN reflects data as of April 2024 (MTNHP 2024b).

MTNHP Primary Name *Scientific Name*[b] Common Name[c]	State Distribution Pattern[d]	Global Rank[e]	State Rank[f]	Montana State Status[g]	Federal Designations ESA[h] BLM[i] USFS[j]	Montana State Threat Score[k]	Climate Change Vulnerability Index[l]	Number of SOs[m]	Select Reasons for Being Plant Species of GCN[n]
Leptodactylon caespitosum Matted Prickly-phlox		G4	S2S3	SOC		Low	Moderately Vulnerable	29	Threat
Lewisia columbiana Columbia Lewisia	peripheral	G4G5	S1S2	SOC	**USFS:** Sensitive-Known (BD)	Medium - Low		5	Threat
Lilium columbianum Columbia Lily		G5	S2	SOC		No Known Threat	Moderately Vulnerable	11	Threat?; Bedrock Glades GCN
Liparis loeselii Loesel's Twayblade		G5	S2	SOC	**USFS:** Species of Conservation Concern (FLAT)	Unknown	Extremely Vulnerable	11	Peatland [Fen] GCN
Lobelia kalmii Kalm's Lobelia		G5	S3	SOC		No Known Threat		30	Peatland [Fen] GCN
Lomatium nuttallii Nuttall Desert-parsley	disjunct	G3	S2	SOC	**BLM:** Sensitive USFS: Species of Conservation Concern (CG)	High - Medium	Moderately Vulnerable	3	Threat; Shale Barrens GCN?
Malacothrix torreyi Desert Dandelion	peripheral	G4	S1S2	SOC		No Known Threat		12	Sagebrush Communities GCN
Mentzelia pumila Dwarf mentzelia	regional endemic	G4	S2S3	SOC		Unknown	Moderately Vulnerable	22	Information Needs (PSGIN)
Mimulus breviflorus Short-flowered Monkeyflower		G4	S1S2	SOC	**USFS:** Sensitive-Known (KOOT); Species of Conservation Concern (FLAT)	Unknown?	Moderately Vulnerable	13	Theats?; Information Needs (PSGIN)
Mimulus nanus Dwarf Purple Monkeyflower		G5	S2S3	SOC	**USFS:** Sensitive-Known (BRT); Species of Conservation Concern (CG)	High - Low	Extremely Vulnerable	21	Threat
Mimulus primuloides Primrose Monkeyflower		G4	S3	SOC	**USFS:** Sensitive-Known (BD, BRT)	Low	Extremely Vulnerable	42	Peatland [Fen] GCN

Table 4-2. [continued from page 13] The 86 vascular Plant Species of Greatest Conservation Need in Montana categorized as Priority 2a. Information on their distribution, ranks, status, designations, threats, occurrences, and select reasons for inclusion as a GCN reflects data as of April 2024 (MTNHP 2024b).

MTNHP Primary Name *Scientific Name*[b] Common Name[c]	**State Distribution Pattern[d]**	**Global Rank[e]**	**State Rank[f]**	**Montana State Status[g]**	**Federal Designations ESA[h] BLM[i] USFS[j]**	**Montana State Threat Score[k]**	**Climate Change Vulnerability Index[l]**	**Number of SOs[m]**	**Select Reasons for Being Plant Species of GCN[n]**
Muhlenbergia andina Foxtail Muhly	scattered	G4	S2S3	SOC		Unknown		14	Hot Springs (Sensitive Area, not GCN)
Nama densum Nama	peripheral?	G5	S1S2	SOC		Unknown		1	Sagebrush Communities GCN
Nuttallanthus texanus Blue Toadflax		G4G5	S1S2	SOC		High - Medium		4	Threat
Oenothera pallida* ssp. *pallida Pale Evening-primrose	peripheral or disjunct	G5T4	S1	SOC		Unknown	Extremely Vulnerable	8	Centennial Valley Sand Dunes GCN
Ophioglossum pusillum Adder's Tongue		G4	S3	SOC			Moderately Vulnerable	47	Peatland [Fen] GCN
Oxytropis campestris* var. *columbiana Columbia Locoweed	regional endemic	G5T2	S1	SOC		Very High	Extremely Vulnerable	15	Threat
Pedicularis crenulata Scallop-leaf Lousewort		G4	S1	SOC	**BLM:** Sensitive	High	Extremely Vulnerable	4	Threat; Information Needs (PSGIN)
Penstemon angustifolius Narrowleaf Penstemon		***G5***	S2S3	SOC		No Known Threat	Highly Vulnerable	19	Other Sandy Habitats GCN?
Penstemon payettensis Payette Beardtongue	regional endemic	G4	S1	SOC	**USFS:** Sensitive-Known (BD, BRT)	Very High		11	Sagebrush Communities GCN
Petasites frigidus* var. *frigidus Arctic Sweet Coltsfoot	peripheral	G5T5	S2	SOC	**USFS:** Species of Conservation Concern (FLAT)	Medium	Moderately Vulnerable	11	Sagebrush Communities GCN
Phegopteris connectilis Northern Beechfern		G5	S2S3	SOC	**USFS:** Sensitive-Known (KOOT)	Medium - Low	Moderately Vulnerable	27	Threat
Physaria carinata Keeled Bladderpod	regional endemic	G3G4 TNR	S1S2	SOC	**BLM:** Sensitive **USFS:** Sensitive-Known (BD)	Medium	Moderately Vulnerable	46	Metamorphosed Limestone GCN?; Threat

Table 4-2. [continued from page 14] The 86 vascular Plant Species of Greatest Conservation Need in Montana categorized as Priority 2a. Information on their distribution, ranks, status, designations, threats, occurrences, and select reasons for inclusion as a GCN reflects data as of April 2024 (MTNHP 2024b).

MTNHP Primary Name *Scientific Name*[b] Common Name[c]	State Distribution Pattern[d]	Global Rank[e]	State Rank[f]	Montana State Status[g]	Federal Designations ESA[h] BLM[i] USFS[j]	Montana State Threat Score[k]	Climate Change Vulnerability Index[l]	Number of SOs[m]	Select Reasons for Being Plant Species of GCN[n]
Physaria humilis Bitterroot Bladderpod	state endemic	G2	S2	SOC	**USFS:** Sensitive-Known (BRT)	High - Medium	Highly Vulnerable	9	Threat
Physaria klausii Divide Bladderpod	state endemic	G3	S3	SOC		Low	Moderately Vulnerable	59	Threat; Shale Barrens GCN?
Physaria lesicii Lesica's Bladderpod	state endemic	G2	S2	SOC	**BLM:** Sensitive	High - Medium	Highly Vulnerable	19	Threat
Pleiacanthus spinosus Spiny Skeletonweed	peripheral	G4	S2S3	SOC	**BLM:** Sensitive	Unknown	Moderately Vulnerable	27	Information Needs (PSGIN)
Prunus pumila Sand Cherry	peripheral	G5	S1S3	SOC		Unknown		2	Poorly Documented (PSGIN)
Ranunculus orthorhynchus Straightbeak Buttercup	peripheral	G5	S1S2	SOC		Low		15	Threat; Poorly Documented (PSGIN)
Rotala ramosior Toothcup		G5	S1S2	SOC		No Known Threat	Highly Vulnerable	7	Information Needs (PSGIN)
Sandbergia perplexa Puzzling Rockcress	regional endemic	G4	S2	SOC	**USFS:** Sensitive-Known (BRT)	High - Low	Highly Vulnerable	18	Threat; Sagebrush Communites GCN
Scheuchzeria palustris Pod Grass		G5	S3	SOC	**USFS:** Sensitive-Known (LOLO)	Medium - Low	Moderately Vulnerable	60	Threat; Peatland [Fen] GCN
Sidalcea oregana Oregon Checker-mallow		G5	S2S3	SOC	**USFS:** Species of Conservation Concern (CG)	High - Medium		10	Threat
Tetradymia spinosa Short-spine Horsebrush	peripheral	G5	S2S3	SOC		Unknown?	Less Vulnerable	12	Threat?; Information Needs (PSGIN); Sagebrush Communities GCN

Table 4-2. [continued from page 15] The 86 vascular Plant Species of Greatest Conservation Need in Montana categorized as Priority 2a. Information on their distribution, ranks, status, designations, threats, occurrences, and select reasons for inclusion as a GCN reflects data as of April 2024 (MTNHP 2024b).

MTNHP Primary Name *Scientific Name*[b] Common Name[c]	State Distribution Pattern[d]	Global Rank[e]	State Rank[f]	Montana State Status[g]	Federal Designations ESA[h] BLM[i] USFS[j]	Montana State Threat Score[k]	Climate Change Vulnerability Index[l]	Number of SOs[m]	Select Reasons for Being Plant Species of GCN[n]
Trichophorum cespitosum Tufted Club-rush		G5	S2	SOC	**USFS:** Species of Conservation Concern (FLAT)	No Known Threat	Moderately Vulnerable	27	Peatland [Fen] GCN
Trifolium eriocephalum Woolly-head Clover	peripheral	G5	S2	SOC	**USFS:** Sensitive-Known (BD, BRT); Sensitive-Suspected (LOLO)	Medium - Low		31	Theat; Riparian Forest GCN
Trifolium gymnocarpon Hollyleaf Clover	peripheral and disjunct	G5	S2	SOC	**USFS:** Sensitive-Known (BD, BRT, LOLO)	Medium - Low		63	Theat; Sagebrush Communities GCN
Trifolium microcephalum Woolly Clover	peripheral or scattered	G5	S3	SOC		High - Medium		10	Theat; Riparian Forest GCN
Utricularia intermedia Flatleaf Bladderwort		G5	S2		**USFS:** Sensitive-Known (KOOT)	No Known Threat		11	Peatland [Fen] GCN
Vaccinium myrtilloides Velvetleaf Huckleberry	peripheral	G5	S2	SOC		Medium - Low	Less Vulnerable	14	Threat
Viburnum lentago Nannyberry	scattered	G5	S2S3	SOC		Unknown		4	Poorly Documented (PSGIN)

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[a] Strategy Priority: Priority 1 species have more rigorous observation and mapping data, at least some monitoring data or research, and/or biological literature. Less is known about Priority 2 plant species - beyond accurate observation data and, for some species, moderately precise mapping.

[b] Scientific Name used as the primary name in the MTNHP botany database (MTNHP 2024b).

[c] Common Name used as the primary name in the MTNHP botany database (MTNHP 2024b).

[d] Distributional pattern of the plant in Montana based on literature (Lesica 2022) and botanical expertise.

[e] Global Rank as determined by NatureServe (2024). Refer to Box 4-1 and NatureServe Explorer: https://explorer.natureserve.org/

[f] State Rank as determined by MTNHP (2024b). Refer to Box 4-1 and MTNHP Montana Field Guide: https://fieldguide.mt.gov/default.aspx

[g] Montana Status: State-level designation (MTNHP 2024b) or other "of concern" notation.

[h] US Fish and Wildlife Service's designation under the Endangered Species Act (MTNHP 2024b).

[i] Montana/Dakotas Bureau of Land Management (BLM) designation (MTNHP 2024b).

[j] Region 1, US Forest Service (USFS) designation by forest (MTNHP 2024b).

[k] Montana State Threat Score (MTNHP Threat Assessment 2021).

[l] Climate Change Vulnerability Index score. See Box 4-5 for definitions (MTNHP 2021).

[m] Number of Species Occurrences (extant, extirpated, and historical) mapped by MTNHP as of March 2024 (MTNHP 2024b). NA means "not applicable".

[n] A selection of abbreviated reasons for being a Plant Species of Greatest Conservation Need (GCN) and Plant Species of Greatest Inventory Need (SPGIN).

Locations for Plant Species of Greatest Conservation Need

Populations of the 109 Plant Species of GCN are found across Montana, occurring in numerous types of habitats and on a variety of land ownerships (Figure 4-1). A greater percentage of the species and their occurrences are found in the western third of the state. This skewed distribution is likely a result of the great topographic relief combined with climate patterns and other factors in western Montana that create a greater array of habitats for species to occupy. The skewed distribution also reflects the level of botanical exploration since large portions of central and eastern Montana remain under-surveyed.

Habitats and Plant Species of GCN

Ecologists working for the Montana Natural Heritage Program use the Ecological Systems classification (Comer et al. 2003) to understand the general composition, distribution, and condition of biological communities in Montana. An Ecological System represents a biological community or a major grouping that re-occurs across the landscape in similar physical environments and is influenced by similar (yet dynamic) ecological processes, such as fire or flooding (MTNHP 2024c). The classification also includes a human land use class in Montana. There are eight Level-1 Ecological System (ES) communities or major groupings that have been mapped across the state (Figure 4-2) (MTNHP 2024c). The largest Level-1 ES are Grasslands, which cover just under 30% of the state's land. Following

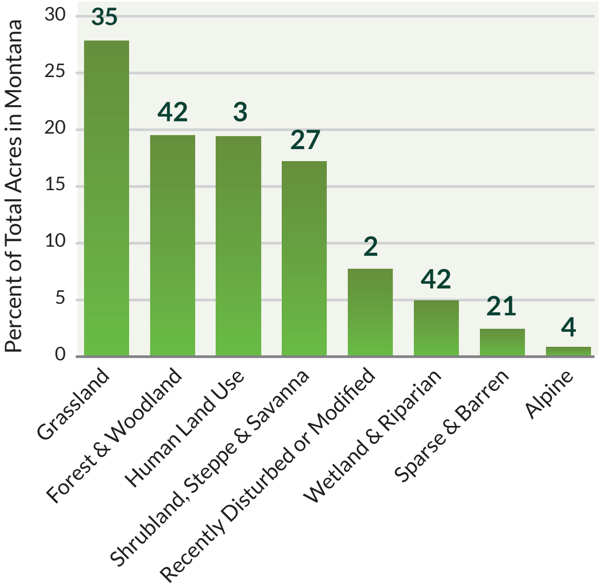

Figure 4-2. The percentage of total acres in Montana for each Level-1 Ecological System. The number of Plant Species of GCN found in each Level-1 Ecological System is listed above the bar. Note: Most species are found in more than one Level-1 Ecological System. *Data Source: MTNHP 2024c.*

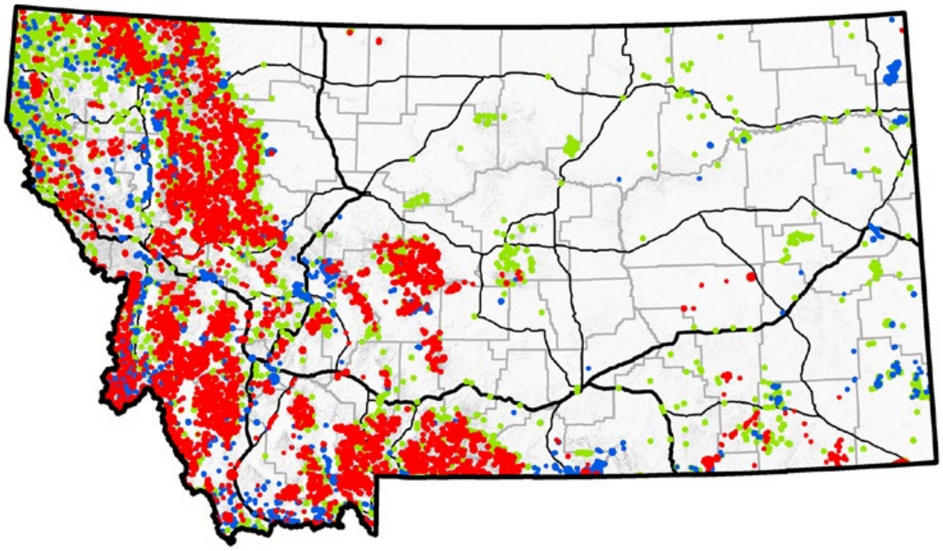

Figure 4-1. The distribution of Plant Species of GCN in Montana. Priority 1 SOC plants are in red. Priority 2 SOC plants are in blue. Priority 1 and 2 plants of management concern are in green.

Photo Credit: Henry Hardin

*Photo 4-5. Short-spined Horsebrush (*Tetradymnia spinosa*) shrubs grow in very sandy, and often alkaline, soils. This population occurs in Yellowstone National Park, Montana.*

Photo Credit: Clint Whittle-Frazier

*Photo 4-6. A Citizen Botanist conducts a survey for Small Onion (*Allium parvum*) by meandering through sagebrush steppe habitat in southwest Montana.*

in acreage are the Forest and Woodland, Human Land Use, and Shrubland, Steppe, and Savanna Level-1 ES with each occupying just under 20% in Montana. The Recently Disturbed or Modified Level-1 ES accounts for 8% of Montana; these are places in ecological transition resulting from timber harvests, wildland fires, insect-killed trees, reforestation, or colonized by introduced vegetation. The Wetland and Riparian Level-1 ES accounts for about 5% of Montana. Sparse and Barren Level-1 ES, such as sand dunes, badlands, and cliffs, occupy about 3% of Montana. The Alpine Level-1 ES, which occupies the highest elevational habitat, accounts for the least acreage, at 1% of Montana.

Plant Species of GCN are found in all eight of the Level-1 Ecological System groupings in Montana (Figure 4-2) (MTNHP 2024b). The Forest and Woodland and Wetland and Riparian Level-1 ESs have the greatest number of GCN plants at 42 species each. Following in numbers of GCN plant species is the Grassland, Shrubland, Steppe, and Savanna, and Sparse and Barren Level-1 ESs. Although the Sparse and Barren Level-1 ES accounts for less than 5% of the land base, it is habitat for 20% of GCN plant species. The low number of GCN plant species supported by the Alpine Level-1 ES is most likely a reflection of intact native habitat experiencing few documented threats[6]. The Human Land Use Level-1 ES, which consists of mines, roads, and cultivated areas, and the Recently Disturbed or Modified Level-1 ES, contain only a few GCN plant species.

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[6] The MTNHP Threat Assessment (2021) and Climate Change Vulnerability Index (2021) acknowledges that climate change is projected as a major threat for many alpine SOC vascular plants; however, actual data has been sparse or lacking for assessed plant species.

Land Ownership and Plant Species of GCN

Montana has a diverse land ownership (Figure 4-3) (MTNHP 2024d). More than 50% of the state is privately owned. Nearly 28% of the land base is under federal management, including 18% USFS, approximately 9% Montana/Dakotas BLM, and just over 1% National Park Service. Tribal nations own about 9% of the land base. The State of Montana itself owns relatively little land, at about 6%. Conservation easements under private, federal, state, or other ownerships account for just under 5% of the land base. The remaining 4% is owned by local governments and others.

Plant Species of GCN are found in all categories of land ownership in Montana (Figure 4-3). Nearly 70% of GCN plant species have at least one population on privately owned lands. Consequently, private landowners play an important role in conserving our state's rare species and native flora. Almost all GCN plant species have at least one population on federal lands: USFS-Region 1, MT/Dakotas BLM, and National Park Service (NPS). While the NPS occupies less than 2% of Montana's land base, it supports populations for almost a third of the GCN plant species. State of Montana lands support populations of at least 40% of the GCN plant species. Nearly a third of GCN plant species have at least one population on lands under conservation easements. Tribal lands support populations of about 20% of the GCN plant species. Even local government lands support many Plant Species of GCN.

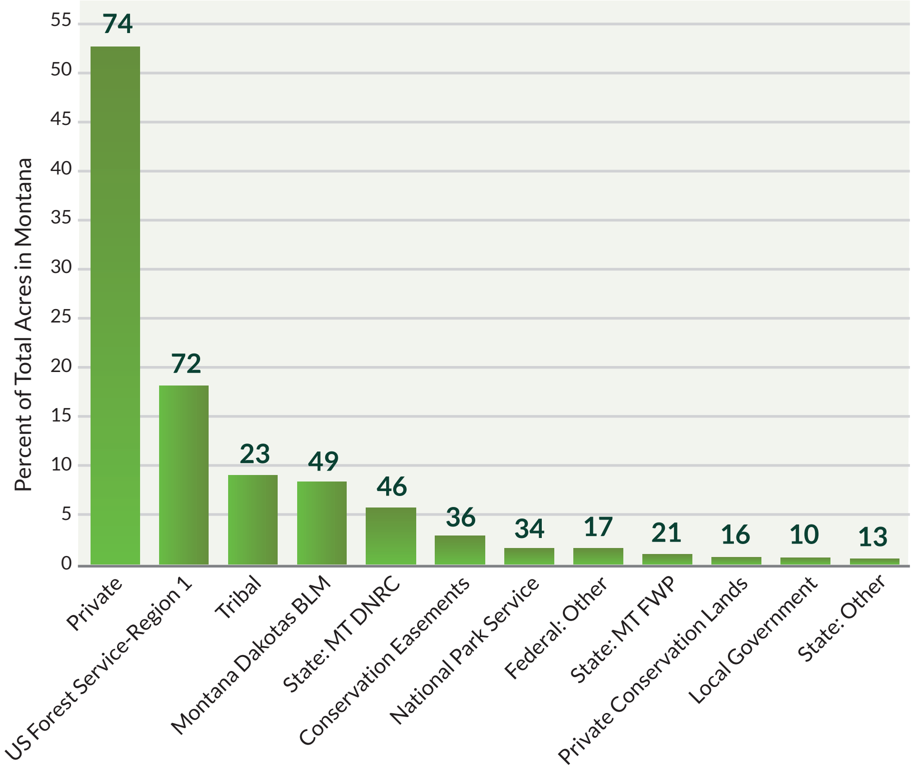

Figure 4-3. The percentage of total acres in Montana by land ownership category. The number of Plant Species of GCN found in each land ownership type is listed above the bar. *Note: Most species have populations in more than one land ownership category. Data Source: MTNHP 2024d.*

Challenges Faced by Plant Species of Greatest Conservation Need

For Plant Species of GCN and other rare plants, challenges to their persistence can come from both natural and anthropogenic sources. Many of these plant species are naturally rare because they are restricted to very specific habitats or rely on specific climatic conditions. Others are rare or in decline from actions directly or indirectly related to humans. Montana's human population has now exceeded one million people, which is a significant statistic for a rural state (US Census Bureau 2024). As Montana's population grows and shifts, conservation planning becomes increasingly necessary to avoid placing these plant species at further risk from detrimental human activities, such as habitat degradation. It is also important to know which species are facing specific threats and where their populations are secure or threatened.

To understand the stressors or factors that may threaten the persistence of Montana's Plant Species of GCN and other rare plants, the Montana Native Plant Society (MNPS) and MTNHP teamed up in 2006 to collect data on reported threats. Today, the MTNHP tracks reported threat data, and uses NatureServe methods to convey their impact through a State Threat Score (Box 4-3). Below, we summarize the common or serious human activities that can negatively impact one or more populations of Plant Species of GCN, other rare plants, and habitats, thereby increasing their risk of extirpation in Montana.

Altered Hydrological Regimes

The natural volume, flow, and distribution of water within Montana has changed since European settlement. Manmade structures such as dams, irrigation ditches, and diversions can interrupt the natural patterns of flooding and drying. Altering stream channels, especially through straightening, and filling in wetlands changes the availability of water in terms of timing, duration, and/or volume. Depending upon the species and its biological attributes, modifying hydrology can benefit or hinder the persistence of Plant Species of GCN. Examples of species that require periods of flooding followed by drying in the growing season to carry out their life cycle include Ute Ladies'-tresses, Water Howellia, and Scarlet Ammannia (*Ammannia robusta*) (Fertig et al. 2005; USFS 1997; Scarlet Ammannia Recovery Team 2008).

> *Because they are rooted in place, plants can't move out of the way of an oncoming bulldozer or take shelter until danger passes. And because many rare plants are highly localized, growing only in very specific soils or micro-climates, they are particularly susceptible to being wiped out, often without anyone's knowledge. They are, in effect, hidden in plain sight.*
>
> ~ Stein and Gravuer, NatureServe 2008

Invasive Species and Noxious Weeds

Noxious and invasive non-native species cause harm to Plant Species of GCN, other native

Photo Credit: Andrea Pipp

Photo 4-7. Cheatgrass (Bromus tectorum) *invading into a native community of Big Sagebrush* (Artemisia tridentata)*. Given time the buildup of Cheatgrass litter can alter the natural fire regime of this habitat.*

Box 4-3. NatureServe's Threat Assessment: Factors for evaluating a species' risk (Master et al. 2012).

THREAT DEFINITION

The proximate activity or process that has caused, is causing, or may cause the destruction, degradation, and/or impairment to the species. Threats may be related to human activities or may be natural.

FACTORS TO ASSESS

Intrinsic Vulnerability
The observed, inferred, or suspected degree to which characteristics of the species make it vulnerable or resilient to natural or anthropogenic stresses or catastrophes.
Examples: reproductive rates, time to maturity, dormancy requirements, dispersal patterns.

Threat Categories (Types)
A list of at least 100 major threat types developed by the IUCN:
https://www.iucnredlist.org/resources/threat-classification-scheme

The IUCN list provides consistency for reporting and analysis. For each threat type, timing, scope, and severity are assessed, as follows.

Timing: Past, ongoing, or future. Note that only ongoing threats are used to assign a threat score.
High: Threat is operational (happening now).
Moderate: Threat is likely to be operational within the short term.
Low: Threat is likely to be operational in the long term.
Insignificant: Threat may exist but is not likely to be operational within the scope of this analysis.

Scope: Number of Species Occurrences (SOs) or proportion of all observations across the state affected by the threat type.
Pervasive: 71-100% of total population or area affected
Large: 31-70% of total population or area affected
Restricted: 11-30% of total population or area affected
Small: 1-10% of total population or area affected
Negligible: less than 1% of total population or area affected
Unknown

Severity: Overall decline caused by the threat. Severity is determined at the observation or SO levels.
Extreme: 71-100% decline in observed population
Serious: 31-70% decline in observed population
Moderate: 11-30% decline in observed population
Slight: 1-10% decline in observed population
Negligible: less than 1% decline in observed population.
Neutral or Potential Benefit
Unknown

RANK CALCULATOR

Developed by NatureServe the Conservation Rank Calculator is a tool that automates the process of assigning a species' conservation status rank (G-Rank and S-Rank) and its level of risk to extirpation in Montana while allowing for a manual override.

plants, cultural resources, the economy, and human health (MISC 2024). They threaten native plants because non-natives lack vectors that control their growth and reproduction, such as other organisms that will eat them, cause disease, or heavily compete for water and nutrients. Some noxious and invasive plants colonize niches that were previously unoccupied by native plants, especially in drier habitats such as grasslands and shrublands. Noxious and invasive species are highly successful at capturing nutrients and water and suppressing other plants; they grow and reproduce rapidly. As an example, Spotted Knapweed (*Centaurea stoebe*), a noxious weed, can suppress seed germination and establishment of Sapphire Rockcress (*Boechera fecunda*), a Plant Species of GCN that is restricted to a Unique Habitat of GCN (Lesica and Shelly 1996; see conservation profiles in Appendices A and B). Some invasive plants, such as Cheatgrass (*Bromus tectorum*) can permanently modify both the ecology and species composition of a native plant community (Photo 4-7). Some other non-native plants, not officially designated as noxious or invasive, can also harm native plants and habitats. Some of these non-native plants are still used for ornamental, agricultural, or rangeland purposes, such as Smooth Brome (*Bromus inermis*), Crested Wheatgrass (*Agropyron cristatum*), and Baby's-breath (*Gypsophila* spp.). Other non-native plants, including some garden plants, may escape cultivation and become problematic in certain parts of the state or under specific environmental conditions.

Federal and state land management agencies, county weed districts, and private landowners play a huge role in managing noxious and invasive non-native plant species in Montana. Montana is fortunate to have several key partners who work with all land management agencies, county governments, and landowners on noxious and invasive species prevention, management, and education (Box 4-4).

Box 4-4. Important partners and resources in Montana for the prevention, education, and control of noxious and invasive species.

Montana Invasive Species Council (MISC)

The Council is a diverse group of scientists and resource managers charged with identifying priority invasive species issues and making recommendations to improve invasive species management (MISC 2024): https://invasivespecies.mt.gov/misc/about-us

Montana Department of Agriculture (MDA)

Designates noxious plant species and provides state coordination, educational resources, early detection and rapid response (EDRR), weed free certification of materials, and funding. Funding supports county and tribal weed programs, research and development, local & statewide educational programs, EDRR program, and local cooperative-landowner cost share projects.

- Montana Noxious Weed Management Plan (MDA 2017): https://agr.mt.gov/_docs/NWTF-docs/MT-Noxious-Weed-Management-Plan--Update-2017.pdf
- Montana Noxious Weed Programs: https://agr.mt.gov/Noxious-Weeds

County Weed Districts

Provides education and assistance to the public on proper plant identification, integrated weed management of noxious weeds, and is responsible for administering the Montana Local County Weed Control ACT: https://leg.mt.gov/bills/mca/title_0070/chapter_0220/part_0210/sections_index.html

Montana Weed Control Association (MWCA)

- A non-profit partner that facilitates long-term, ecologically based, integrated weed management programs (MWCA 2024).
- Provides coordination and education for federal, state, and county professional weed managers, educators, and landowners; website provides contact information for county weed districts. https://www.mtweed.org/

MSU Extension Services

- Schutter Diagnostic Lab: Helps landowners identify plants, diagnose plant diseases and insect damage, and solve other problems: https://www.montana.edu/extension/diagnostics/
- Local Extension offices serve 56 counties and 7 reservations: https://www.montana.edu/extension/localoffices.html

Mining

Mining has been part of Montana's economy since the early 1800s. The General Mining Act of 1872 authorizes and governs prospecting and mining for economic minerals on federally-owned public lands. Passage of this federal law led to the establishment of thousands of mines in Montana, and to our state's nickname as The Treasure State (Anderson 2020). Today, coal, hard rock[7], and opencut[8] mining on public and private lands remains as important components of Montana's economy.

Although mining results in ground disturbance and can negatively impact native plants, laws and policies that govern remediation and reclamation can mandate the use of native plant materials, native soils retention, and other beneficial actions. For example, Woolly Twinpod (P*hysaria didymocarpa* var. *lanata*) is a Plant Species of GCN that has been impacted by past mining; a mine company is actively working to propagate and re-establish populations (Glenn 2021). Potential negative impacts from mining activities include trampling and direct removal of plants. Potential indirect negative impacts include habitat disturbance, soil erosion, altered hydrology (volume, duration, and water quality), soil compaction, disruption or elimination of soil biota, concentration of heavy metals, and colonization by invasive species.

Tourism, Plant Collecting, and Motorized Recreational Activities

Montana is a destination state for tourists, especially those looking for outdoor activities. Tourism is a significant portion of Montana's economy and can both help and hinder plant conservation[9]. Tourism can aid plant conservation efforts by increasing public awareness and appreciation for Montana's Plant Species of GCN and other native flora. Habitat-based (camping, hiking, rafting, and others) and plant-based (foraging, viewing, field trips, and others) experiences can bolster Montana's economy, but over-collecting and/or excessive disturbance to native plant species can occur and reduce population viability.

Photo Credit: Andrea Pipp

Photo 4-8. An active gold mine in Silver Bow County, Montana.

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[7] Hard Rock are metals and minerals (MTDEQ 2024).

[8] Opencut minerals include bentonite, clay, scoria, soil materials, peat, sand, and gravel (MTDEQ 2024).

[9] The Montana Resiliency Plan aims to help local communities adapt and recover from social, economic, and environmental disruptions: https://redesign-commerce.mt.gov/Business/Programs-and-Services/Tourism-Marketing/Tourism-Grant-Program/Resiliency-Plan-Implementation-Grant-Program

Recreational activities can also negatively impact native habitats and rare plants if not managed properly. Plant collecting, whether for food, floral arrangements, or wildcrafting, can lead to unsustainable practices. Motorized recreation, including off-highway, off-road (ORV), all-terrain (ATV), and four-wheel drive vehicles, motorcycles, and snowmobiles, is increasingly popular and often difficult to regulate or prevent in places where Plant Species of GCN and other rare plants occur. Douglas' Bladderpod (*Physaria douglasii*), a Plant Species of GCN, is known from one general area in northwest Montana where its habitat is also used for motorized recreation (MTNHP Threat Assessment 2021). Thrill-seekers and organized competitions now advocate breaking natural barriers, allowing motorized vehicles into areas previously thought to be inaccessible. In Montana, unauthorized motorized recreation in the Italian Peaks area occurs where several rare plants are found, such as Pink Coil-beaked Lousewort (*Pedicularis contorta* var. *ctenophora*) (MTNHP Threat Assessment 2021).

Residential, Commercial, and Transportation Development

Montana's population is growing denser and urban areas are expanding (US Census Bureau 2024). Expanding residential and urban development, along with associated infrastructure (roads, utilities, trails, and flood-control systems), is reducing and fragmenting important habitat for native plants and plant communities. For Plant Species of GCN, Ute Ladies'-tresses and Velvetleaf Huckleberry (*Vaccinium myrtilloides*) have had a decrease in population size at specific sites due to development (MTNHP Threat Assessment 2021). Exurban development (low-density rural development), which is the fastest-growing land use in the United States, has been found to reduce many native species near homes and increase exotic species, with effects manifested over decades (Hansen et al. 2005). In addition to local impacts, exurban development may alter ecological processes and biodiversity on adjacent and distant public lands. Underlying mechanisms involve alteration of ecological processes and biotic interactions, introduction of invasive species, habitat fragmentation, and increased human disturbance (Hansen et al. 2005).

Photo Credit: Matthew Stewart, 406 Stewart Photography

Photo Credit: Erin Carroll

*Photos 4-9a/b. Columbia Lily (*Lilium columbianum*) grows in moist forest openings of northwest Montana. Where roadways intersect its habitat, these showy plants can be over-harvested by people wanting to make a pretty bouquet or add to their garden. Unfortunately, transplanted native lilies usually die.*

Roads can have a serious negative impact on the natural integrity and habitat suitability of rare plant sites. Along with extirpating populations and destroying habitat, roads contribute to fragmentation that may interfere with natural processes such as pollination and seed dispersal. Other impacts from road construction and maintenance (e.g., mowing and herbicide application) include erosion, sedimentation, increased soil toxicity, and vectors for invasive species spread.

Agricultural Development

Montana's agricultural industry provides a variety of foods for local, national, and international consumption; strengthens local economies throughout the state; and for certain commodities is strongly interdependent with native plant conservation. Proper inventory and use of native plant communities is especially important for livestock production operations in central and eastern Montana. Production of native plant materials – seedstock and live seedlings – that are well-adapted to the state can improve conservation practice technologies and enhance natural resource protection. The Bridger Plant Materials Center[10] in Bridger, Montana has selected and released native grasses, forbs, shrubs, and tree species and germplasm for commercial seed increase and use in revegetation projects through the state (NRCS 2024).

Conversely, agricultural practices that plow native or intact grassland habitat can harm native plants, habitat, and pollinators. In the Northern Great Plains, which includes two-thirds of Montana, intact grasslands continue to be plowed at large-scale and converted to commodity crops (wheat, corn, soybeans, and rice) (WWF 2023). Although some conversion does yield a human food product, a large amount is subsidized by crop insurance programs or ultimately exported solely as biofuel (WWF 2023). However, through collaboration, policies can be improved to conserve land, soil, and water resources (WWF 2023) (see Section 3, Policy/Regulation Conservation Objective, #8). The Plant Species of GCN, Scallop-leaf Lousewort (*Pedicularis crenulata*), has been negatively impacted by agricultural practices that use native riparian meadows for haying operations.

Altered Disturbance Regimes

Some Plant Species of GCN and other native plants require ecological disturbances to sustain their populations. Such native plants rely on a certain amount, frequency, or duration of disturbance to maintain their preferred environmental conditions - stimulate germination or growth, transport seeds, and/or reduce competition with other vegetation. In Montana, the most common, and often natural, disturbance regimes are native and domestic ungulate grazing and browsing, wildland fire, and flooding. Alterations to the historic frequency and intensity patterns of these disturbance regimes can lead to population declines and natural plant succession that will eventually diminish or eradicate the species' required habitat.

Browsing and Grazing

Grasslands, and most of the native species within them, co-evolved with a variety of grazing animals. In Montana, grasslands were historically grazed by large herds of bison, and also by deer, elk, and pronghorn. Today, much of the grassland biome is managed by either a livestock operation on private lands or through grazing permits and leases that authorize use on federal or state public lands that are designated in land use plans. Proper land stewardship seeks to manage livestock and native ungulate grazing with a frequency, duration, and intensity that maintains plant diversity and forage levels. Many Plant Species of GCN and other native plants require a certain amount of browsing or grazing, and/or some ground surface disturbance to retain healthy viable populations, early-successional habitat, or other environmental conditions. Plant Species of GCN that require these types of disturbance include Ute-ladies'-tresses, Spalding's Catchfly, and Quaking Aspen (*Populus tremuloides*) (Fertig et al. 2005; USFWS 2007; Rogers 2017).

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[10] USDA, Natural Resources Conservation Service, Bridger Plant Materials Center, Montana: https://www.nrcs.usda.gov/plant-materials/mtpmc

Ecologically incompatible grazing or browsing practices can result in the overuse or underuse of the grassland (or rangeland). Overuse can result in excessive herbivory of sensitive plants, trampling of vegetation and soil crust biota, and severe soil compaction of the rangeland. Underuse can result in low levels of herbivory of late-seral grassland species, a build-up of plant litter (thatch), and poor levels of nutrient and organic matter cycling. Indirectly, ecologically incompatible grazing practices change soil moisture and texture which affects plant establishment and growth and alters animal communities, including pollinators. Ultimately, it is the plant community composition along with the timing, intensity, duration, and frequency of grazing that determines if the browsing or grazing by livestock or native ungulates is beneficial or harmful to Plant Species of GCN and other targeted native plant species.

Wildland Fire

Native plant species, including those of GCN, vary in their response to natural wildland fires. Some plant species, such as perennials, can survive a wildfire if their underground buds or roots are not killed. Other species, such as annuals, may not survive if the fire is very intense and causes high soil surface temperatures. Fire can set back the successional development of the vegetation, thereby thinning or reducing plant densities; this can stimulate new growth. For some habitats, the absence of fire can lead to the advancement of succession, increasing plant densities or changing plant species composition through time. In grasslands, the absence of

Photo Credit: Andrea Pipp

*Photo 4-10. A botanist conducts a revisit in 2015 to a Water Howellia (*Howellia aquatilis*) pond. In 2003 this site was completely surrounded by the Crazy Horse Fire, a stand-replacement wildfire.*

fire can lead to dense thatch, lower species diversity, and impede seed germination. It is the timing, intensity (temperature), severity (degree to which a fire consumes vegetation), and duration of a wildland fire, among other environmental factors, that determines how individual species and the whole plant community responds. Plant Species of GCN that can respond positively to natural fire regimes include Spalding's Catchfly, Quaking Aspen, and Lemhi Beardtongue (*Penstemon lemhiensis*). (Lesica 1999; Rogers 2017; Stucki et al. 2013).

Many Indigenous peoples used fire or "Cultural Burning" since time immemorial, to improve the vitality of grasslands and forests and strengthen their resilience (Longknife 2024). Cultural burning has been banned in some states (Longknife 2024). Cultural burning was once a lost tradition, but is now practiced and taught to the young by "Fire Keepers"(Longknife 2024).

Flooding

Refer to the Altered Hydrological Regime in this subsection of the Strategy.

Climate Change

Climate change is one of the greatest threats to the conservation of species and ecosystems and it is having serious impacts across the globe (Neely et al. 2009). The US Global Change Research Program defines climate change as "Changes in average weather conditions that persist over multiple decades or longer. Climate change encompasses both increases and decreases in temperature, as well as shifts in precipitation, changing risk of certain types of severe weather events, and changes to other features of the climate system." (Whitlock et al. 2017).

The Montana Climate Assessment[11] aims to synthesize, evaluate, and share credible and relevant scientific information about climate change in Montana (Whitlock et al. 2017). A few of the major findings from the 2017 assessment are:

- From 1950 to 2015, annual average temperatures as measured by daily minimums, maximums, and averages, have risen across the state by 2 to 3 degrees Fahrenheit.
- From 1951 to 2010, the growing season in Montana increased by 12 days.
- From 1950 to 2015, there have been no historical changes in average annual precipitation, but there are changes in average seasonal precipitation. Average winter precipitation has decreased by 0.9 inch, especially in the western and central portions of the state. Spring precipitation has increased by 1 to 2 inches, especially in the eastern portion of the state.
- The state is projected to continue to warm in all geographic locations, seasons, and under all emission scenarios throughout the 21st century.
- The number of days in a year when daily temperatures exceed 90 degrees Fahrenheit and the number of frost-free days are expected to increase across the state.
- Across the state, precipitation is projected to increase in winter, spring, and fall and decrease in summer.
- Local site and forest stand conditions will influence the effect of increased ambient temperatures on individual tree species, but increased extreme heat will negatively impact species and forest-wide processes.

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[11] 2017 Montana Climate Assessment and 2021 Climate Change and Human Health in Montana reports: https://montanaclimate.org/

- Temperature will drive the direct effects of climate change on individual tree species in energy-limited forests.
- Moisture levels will drive the direct effects of climate change on individual tree species in water-limited forests
- Over the long-term, the speed and magnitude of climate change may mean that higher forest mortality and reductions in forest distribution will be outpaced by gains in forest growth and productivity leading to a net loss in forested areas in the state.

In 2021 the MTNHP conducted a Climate Change Vulnerability Index (CCVI) study on 232 of Montana's SOC vascular plants. The CCVI uses published literature and a scoring system to rapidly assess the vulnerability of a species to climate change (NatureServe 2016) (Box 4-5). The study concluded that of the 232 SOC plants, 45 species (19%) scored as extremely vulnerable, 64 species (28%) as highly vulnerable, 82 species (35%) as moderately vulnerable, and 41 species (18%) as lowly vulnerable to climate change. The study also found that alpine plants in Glacier National Park are less vulnerable to climate change than those in the Beartooth Plateau because the park exhibits less change in moisture and temperature regimes. In addition, species that live in places that exhibit a wide range in precipitation levels are not as vulnerable to climate change. For example, Alpine Poppy (*Papaver radicatum* ssp. *kluanensis*) is less vulnerable to climate change than other alpine plants in this study. A full report has not been written, but CCVI scores can be found on the Montana Field Guide[12] species' profile.

Climate change is directly and indirectly affecting native plant habitats and species, including Plant Species of GCN. In Montana, the density of 28 arctic-alpine and boreal plant species representing 46 populations that occur at the southern margin of their ranges was monitored from 1988 to 2014 (Lesica and Crone 2017). Over the 20-year analysis period, plant abundance declined by an average of 2.3% per year across all populations. Variation among species and within populations of the same species were also observed. However, the degree of plant density decline was greater than the increase. Plant density declined more for dicotyledonous species than for pteridophytes or monocots. The strong overall declining trend occurred simultaneously with warming summer temperatures and/or decreasing precipitation. Included in this study were 5 Plant Species of GCN: English Sundew (*Drosera anglica*), Pod Grass (*Scheuchzeria palustris*), Hudson's Bay Bulrush (*Trichophorum alpinum*), Tufted Club-

Photo Credit: Tim-Spoelma

Photo 4-11. Western White Pine (Pinus monticola) *trees grow in a research plantation on the Swan River State Forest in 2012.*

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[12] MTNHP Montana Field Guide: https://fieldguide.mt.gov/

rush (*Trichorphorum cespitosum*), and Flatleaf Bladderwort (*Utricularia intermedia*).

The full impacts of climate change on Plant Species of GCN and other native species are complex. For example, the effects of climate change were one of four factors that led to the decision to list Whitebark Pine as threatened under the ESA (USFWS 2022). The analysis found, in order of impact, that White Pine Blister Rust, a fungal disease caused by *Cronartium ribicola*, Mountain Pine Beetle (*Dendroctonus ponderosae*), and altered fire regimes are not only major stressors on Whitebark Pine, but individually are also influenced by shifting weather patterns, due to climate change (USFWS 2022). Hence, climate change is directly and indirectly influencing Montana's native plant species, plant communities, and habitats.

Box 4-5. NatureServe's Climate Change Vulnerability Index (NatureServe 2016).

Purpose: The index uses a scoring system that integrates a species' predicted exposure to climate change within a defined assessment area (Montana) with four elements that associate with climate change sensitivity. For three elements, multiple factors are assessed using published studies and expert judgement.

1) Exposure to Local Climate Change
    - Measured by examining the magnitude of predicted temperature and moisture change across the species' Montana range.
    - Downscaled climate predictions made using Climate Wizard: https://www.climatehubs.usda.gov/hubs/southwest/tools/climate-wizard
2) Indirect Exposure to Climate Change
    - Exposure to sea level rise
    - Distribution relative to natural and anthropogenic barriers
    - Predicted impact of land use changes resulting from human responses to climate change
3) Species-Specific Sensitivity
    - Dispersal and movements
    - Predicted sensitivity to temperature and moisture changes
    - Restriction to uncommon geological features or derivatives
    - Reliance on interspecific interactions
    - Genetic factors
    - Phenological response
4) Documented or Modeled Responses to Climate Change
    - Documented response to recent climate change
    - Modeled future change in range or population size
    - Overlap of modeled future range with current range
    - Occurrence of protected areas in modeled future distribution
    - Factors not considered
    - Confidence

Results & Index Score Definitions

Extremely Vulnerable: Abundance and/or range extent in Montana extremely likely to substantially decrease or disappear by 2050.

Highly Vulnerable: Abundance and/or range extent in Montana is likely to decrease significantly by 2050.

Moderately Vulnerable: Abundance and/or range extent in Montana is likely to decrease by 2050.

Not Vulnerable/Presumed Stable: Available evidence does not suggest that abundance and/or range extent in Montana will change (increase/decrease) substantially by 2050. Actual range boundaries may change.

Not Vulnerable/Increase Likely: Available evidence suggests that abundance and/or range extent in Montana is likely to increase by 2050.

Insufficient Evidence: Information about a species' vulnerability is inadequate to calculate an Index score.

CONSERVATION GOALS & OBJECTIVES FOR PLANT SPECIES OF GREATEST CONSERVATION NEED

The intent of the *Strategy* is to promote the collective and coordinated stewardship of Montana's Plant Species of GCN to ensure their viability and persistence. To effectively conserve Plant Species of GCN requires a fusion of academic and pragmatic approaches, so solutions are both innovative and realistic (Given 1994). Effective conservation also depends upon public attitudes, good cost-effective techniques, and developing a range of approaches (Given 1994). These approaches include developing a plant species conservation scorecard; enhancing public education; improving habitat protection and restoration; recognizing or incorporating Native Americans' botanical knowledge; and collaborating on policies that can be applied across jurisdictions. Here in the Plant Species of GCN section of the *Strategy*, we present goals and suggest overarching voluntary objectives from four areas that are pillars of plant species conservation:

- Information Needs [Inventory, Monitoring, Research]
- Protection and Restoration
- Outreach and Education
- Policy and Regulation

Photo Credit: Bruce Selyem

*Photo 4-12. Mealy Primrose (*Primula incana*) grows in moist to wet alkaline meadows. Plants are sustained by balance between proper hydrological conditions and vegetative disturbance.*

The conservation objectives and actions were developed from 2019 to 2024 by a large partnership of biologists, ecologists, botanists, land managers, educators, researchers, and retired professionals working for federal and state land management agencies, Tribal nations, academia, non-governmental organizations, and others (see Table 1 on page *iii*). The objectives are based on agency reports, published literature, professional expertise, and field observations. In addition, conservation objectives from other strategies were reviewed and cross-walked with this *Strategy*[13] to relay the idea that tactics can promote collaboration. Working within and across jurisdictional boundaries, these voluntary conservation objectives are intended to empower land managers, landowners, non-governmental conservation leaders, and individuals who want to contribute to or collaborate on efforts that help sustain Montana's Plant Species of GCN and other native plants across the Montana landscape.

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[13] Montana Forest Action Plan (Montana Forest Action Advisory Council 2020):
https://dnrc.mt.gov/_docs/forestry/Montana_Forest_Action_Plan_12.22.2020.pdf
Montana State Wildlife Action Plan (MFWP 2015):
https://fwp.mt.gov/binaries/content/assets/fwp/gisresources/docs/swap/70169.pdf

Information Needs [Inventory, Monitoring, Research]

Conservation Goal

Through inventory, monitoring, and research, improve scientific understanding of species' interactions and of the natural history, distribution, and population trends for Plant Species of Greatest Conservation Need.

Conservation Objectives

1) Support MTNHP to work with federal, state, and Tribal botanists and land managers to develop a statewide Vascular Plant SOC-PSOC Conservation Scorecard that also includes Plant Species of GCN. Once established, strive to update it every five years. The interactive product (spreadsheet or GIS data layer) would provide a baseline of conditions on the species' distribution, population parameters, types of habitats, level of threats, level of land management protection, and other factors to determine an overall state conservation score of under-conserved, weakly conserved, moderately conserved, or effectively conserved. The scorecard would help identify and prioritize target species for protection, management actions, conservation actions, surveying, monitoring, and filling data gaps. Potential data fields and metrics to use include, but are not limited to:
   - Plant name(s)
   - Global and State Ranks
   - Federal, State, Tribal, and/or local designation
   - Population: measures of statewide population size
   - Habitat categories
   - Distribution categories
   - Threat score, CCVI Index, and/or other metrics of species-level stressors
   - Species Occurrence (SO) score: number, quality rating, and distribution of SOs
   - Landscape Integrity: a measure that captures the intensity of development around SOs
   - Land ownership category: federal, state, private, etc.
   - Land management classifications: wilderness, state trust, Research Natural Area, etc.
   - Other land designations: conservation easement, IPA, etc.
   - Overall conservation score

2) Develop a shared resource to identify and prioritize basic information needs for Priority 2 Plant Species of GCN. Actions include:
   a. Create shared lists or spreadsheets on the *Strategy*'s web page that highlight accomplishments and data gaps relative to information needs. Sharing data products on inventory, monitoring, and research as well as identifying greatest inventory needs could further conservation efforts for the specific Priority 2 Plant Species of GCN. A potential template to use can be found on the *Strategy*'s webpage.

   b. Identify at a coarse level which species are in greatest need of inventory and prioritize locations for inventory, such as by SO, land management unit, or other.

   c. Compile a list of established monitoring protocols and identify the species, authors, and organization.

Information Needs [Inventory, Monitoring, Research]

d. Compile a list of pertinent research with references and links for each species.

e. Compile a list of Best Management Practices, conservation strategies, or other management guidelines for each species, and provide full references or links.

3) Work collaboratively with federal, state, Tribal, and private landowner partners to acquire necessary field data to review and revise the following ranks for Plant Species of GCN using MTNHP/NatureServe methodologies:

a. Subnational Ranks (S-Ranks). An S-Rank indicates the overall risk to extirpation in the state by collectively evaluating the plant's rarity, population trends, and level of threats.

b. Species Occurrence Ranks (SO-Ranks). Strive to update SO Ranks on a five- to ten-year cycle. An SO rank represents the overall "quality" of the site based on an assessment of the plant's population size, habitat quality, landscape context, and abiotic and biotic conditions. Updated and accurate SO ranks are used by managers in planning projects, prioritizing occurrences for restoration, identifying references sites, and aiding management decisions.

c. State Threat Score and rationale. Update the State Threat Score every five years, or as warranted by current data. The State Threat Score represents the degree to which the target plant is degraded by extrinsic factors, which are characterized in terms of threat type, timing, severity, and scope (Master et al. 2012).

4) Help ensure the MTNHP continues to share acquired information and data in a timely fashion with partnering organizations, including federal, state, and local government agencies, Tribal Nations, and NGOs, through communication, data-sharing agreements, funding, and information requests.

Photo Credit: Megan Hessling

*Photo 4-13. Coordinated efforts between the US Forest Service, Montana Native Plant Society, and recreationalists are helping to acquire necessary data that could aid in the conservation of Douglas Bladderpod (*Physaria douglasii*).*

Information Needs [Inventory, Monitoring, Research]

5) Through collaboration, develop survey protocols and standards that apply within and across jurisdictional boundaries where the Plant Species of GCN is found in Montana. For species that have current protocols, review and revise as warranted. Protocols are best developed by people with species-specific knowledge, management authority, and other vested interests.

6) For federal, state, and other partners, consider posting agency reports, status assessments, monitoring protocols, research publications, and other products relevant to Plant Species of GCN on the MTNHP's webpage for the Montana Native Plant Conservation Strategy. Sharing assessment, status, and monitoring reports makes them more accessible to scientists, land managers, decision-makers, and the public.

7) Conduct field-based inventories for each Plant Species of GCN to fill data gaps and increase knowledge about its geographic range, distribution, population size, habitat condition, threats, and status:

    a. Revisit known locations to acquire current mapping and information on population parameters, habitat condition, and threats. Revisit known locations of Plant Species of GCN at least once every ten years to acquire information on presence/absence, population parameters, threats, and habitat condition. Provide information to the land management agency or landowner. See also c and d below.

    b. Conduct surveys in areas of potential or modelled habitat to determine presence, after first securing landowner permission.

    c. Consider providing both positive and negative survey results for the targeted species to the MTNHP for inclusion in the statewide plant and animal database; ensure that landowners and land managers grant permission to share the data.

    d. Consider collecting and submitting field-based data using MTNHP's forms and tools[14].

    e. Collect additional site metrics such as soil, geology, hydrology, associated species, terrain features, population demographics, and other information. Collecting data beyond species presence helps botanists and other land managers revise rankings, improve predictive suitable habitat models, and assist with other conservation tasks.

    f. Document new locations with a voucher specimen, if the population is large and after ensuring that best practices for collection[15], and land management or landowner regulations are followed. Submit to an appropriate Montana or Tribal herbarium (see also Section 4, Outreach and Education Conservation Objective #4; Section 3, Protection and Restoration Conservation Objective #13, and Section 7).

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[14] MTNHP Observation Forms and Tools: https://mtnhp.mt.gov/submit/

[15] Online sources to find "best practices for plant collecting", including these websites:
- MNPS:
  https://mtnativeplants.org/wp-content/uploads/2018/07/MNPS-Guidelines-for-Collecting-Native-Plants-.pdf
- University of Montana Herbarium, How to Press a Plant:
  https://www.umt.edu/herbarium/documents/education/how-press-plants.pdf

Information Needs [Inventory, Monitoring, Research]

8) Where management, human activities, or potential threats occur in vicinity of a Plant Species of GCN, consider designing a monitoring or research study to evaluate any cause and effect. Cause-and-effect monitoring and research studies can inform future mitigation strategies, effects analyses, project planning, and assist in developing best management practices for the target plant. Types of activities or threats to monitor include, but are not limited to:
   - Forestry prescriptions
   - Noxious weed or invasive species incursions
   - Herbicide treatments
   - Wildland fire or prescribed fire treatments
   - Motorized vehicle use
   - Livestock grazing prescriptions
   - Recreational use and/or potential impacts

9) Consult the technical reference *Measuring and Monitoring Plant Populations* (Elzinga et al. 1998) when developing management questions and designing research studies and monitoring projects (refer to Resources section).

Photo Credit: Andrea Pipp

*Photo 4-14. Montana's iconic riparian forests face threats from non-native invaders. In the floodplain, Plains Cottonwood (*Populus deltoides*) grows well, but is met with competition from Salt Cedar, (*Tamarix ramosissima*), a noxious weed. Along the riverbank Russian Olive, a regulated weed, establishes.*

Information Needs [Inventory, Monitoring, Research]

10) Support, fund, or conduct research on specific Plant Species of GCN that focus on, but is not limited to:
    - reproductive biology (e.g., pollination, breeding system, seed dispersal mechanisms)
    - life history (e.g., germination requirements, growth, survival to reproduction)
    - ecology (e.g., edaphic [soil] requirements and mycorrhizal fungi relationships)
    - important environmental processes needed for survival (e.g., fire, hydrological disturbances)

11) Conduct systematics and genetic research of Plant Species of GCN. Priority species include, but are not limited to:
    - Red Alder - *Alnus rubra*: Montana's populations occur at the eastern edge of its range. It is unclear whether Montana's populations are genetically pure species or hybrids.
    - Howell's Gumweed - *Grindelia howellii*[16]: Well-designed research studies that further examine the genetic relationships of species within the *Grindelia* genus, including *Grindelia howellii*, would help manage and protect this plant.

12) Identify and prioritize research needs for Plant Species of GCN that would bolster policy decisions and share these priorities with the academic community and other partners.
    - The USFS has produced species conservation assessments for many plants in the Pacific Northwest and Great Plains regions that provide a sound scientific foundation for management.
    - The USFWS relies on information from inventory, monitoring, and research to guide its Species Status Assessment (SSA) process, which:
        - Provides the scientific background to support ESA decisions, including listing, consultations, status reviews, and recovery plans;
        - Describes the biological and ecological requirements for a species' survival and reproduction, along with its current conditions and potential extinction risks; and,
        - Identifies key knowledge gaps that inventory, monitoring, and research can help address.

13) Conduct Montana-based research to examine plant responses to climate change for Plant Species of GCN and other species with federal or state designations.

14) Write a report on the 2021 Climate Change Vulnerability Index study that assessed 232 SOC vascular plants, and make it available on the MTNHP Strategy's web page.

15) Contribute information to help MTNHP determine or update Climate Change Vulnerability Index scores for Plant Species of GCN and other SOC and PSOC vascular plants. Obtain, read, and share with MTNHP scientific publications that address plant responses to climate for these vascular plants and their close relatives. See also Section 4, Challenges Faced by Plant Species of Greatest Conservation Need, Climate Change.

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[16] Readers interested in *Grindelia howellia* should also consult Williams and White (2017): https://archive.org/details/GrindeliahowelliiGenetics-MontanaMTNHP-USFS2018/mode/2up

Protection and Restoration

Conservation Goal

Secure on-the-ground, site-specific habitat and/or management protection or restoration for Plant Species of Greatest Conservation Need - on public and private lands - and adopt measures for off-site conservation in case native populations are extirpated.

Conservation Objectives and Actions

Photo Credit: Bruce Selyem

*Photo 4-15. Yellow Beeplant (*Cleome lutea*) has an annual life cycle which requires disturbance to maintain populations.*

1) Promote Montana native plant materials that are state-, Tribal-, or locally- sourced for use in landscaping, restoration, remediation, and reclamation projects. Advocate also for the expansion of locally accessible plant material sources throughout the state. Restoring land with accessible state and locally sourced native plant materials increases the probability of their use, creates native habitats, and directly or indirectly benefits Plant Species of GCN and other native plants. Refer also to Section 3, Information Needs Conservation Objective #6 and Protection and Restoration Conservation Objective #5.

2) For Tribal nations in Montana, consider collaborating or partnering with the Montana Department of Natural Resources and Conservation (MTDNRC) nursery as a place to grow-out or increase production of culturally significant plants. The MTDNRC nursery works with all Tribes in Montana and can assist in increasing capacity and providing land for Tribal projects and species. The MTDNRC nursery does not need to retain any Tribal plant materials.

3) Work with the Montana Department of Transportation and the US Army Corps of Engineers to revise goals and credits when a native plant that has cultural value is found and the population can be protected at a wetland mitigation site or bank. Plants that have cultural value are determined by Tribes in Montana as being of great importance as a medicinal, ceremonial, and/or food plant. Restoring wetlands to promote the retention of culturally valued native plants helps ensure wetland function, native species persistence, and the maintenance of Indigenous peoples economies, Traditional Knowledge (TK) systems, and livelihoods. The retention of culturally valued native plants can be done in wetland projects that are on and off Tribal lands.

4) Minimize impacts caused by over-collecting of Plant Species of GCN, their close relatives, and other native plants on with federal, state, Tribal, and other lands. Over-collecting of native plants, especially orchids, ferns, and lilies, reduces population sizes and can hinder reproduction, animal pollinator habitat, and cause other harm. Wildland plants can be harvested or over-collected by people: interested in horticulture, hobby trading, and herbal trading; making voucher specimens for herbaria; and foraging to eat or process foods. Tactics to prevent or minimize over-collecting of plants include, but are not limited to:
   a. Apply the 1-in-20 rule, ensuring that for every collected individual at least 20 others remain untouched[17]. Increase the 20-plant minimum for species with slow reproductive rates, populations that exhibit poor viability, populations that are not widely dispersed, or in other situations.
   b. Monitor to quantify potential impacts from over-collecting, and use results to guide management on the land decisions.
   c. Develop and implement Best Management Practices or other guidelines for sustainable collection of wild native plants on lands in your jurisdiction.
   d. Propagate Plant Species of GCN and other native plants from sustainable methods of seed collecting or from plant materials sourced by the Montana Conservation Seedling Nursery, Tribal nurseries, academic institutions, or other reliable sources.
   e. Comply with all applicable laws and regulations, including landowner policies and federal, state, and Tribal acts, public land policies, harvesting prohibitions, and permitting requirements.
5) Prevent, minimize, and control the spread of noxious and invasive plants and animals, especially in the vicinity of Plant Species of GCN and their habitats, and along roads, trails and other vectors that intersect with their locations. Actions include, but are not limited to:
   a. Support weed managers and landowners in their efforts to obtain the best data and learn how to identify Plant Species of GCN.
   b. Promote the application of national campaigns, specifically, PlayCleanGo[18] and CleanDrainDry[19].
   c. Take action to stop the introduction and spread of existing and new noxious, invasive, and other non-native species. Landowners and others can get help with species identification, prevention, management, and education from state and county agencies (see Box 4-4) such as:
      - MSU Extension Offices and Schutter Diagnostic Lab
      - County weed districts
      - Montana Department of Agriculture
      - Montana Invasive Species Council

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[17] 1-in-20 Rule: https://herbarium.eku.edu/sites/herbarium.eku.edu/files/files/CollectingEthics.pdf
[18] PlayCleanGo - Learn more at: https://playcleango.org/
[19] CleanDrainDry – Learn more at: https://fwp.mt.gov/conservation/aquatic-invasive-species

d. Promote the use of native plant species and sustainably-grown materials in revegetation projects.

e. Use certified weed-free materials in restoration, remediation, and reclamation projects, and when recreating (horseback trail riding; camping; rodeo events; and others) on public lands.

f. Where native species cannot be acquired or used in landscaping, plant non-invasive tree, forb, and grass species.

g. Protect undisturbed native plant communities, especially those with Plant Species of GCN, through on-the-ground habitat protection.

h. Seek federal- or state-level funding for noxious or invasive species control in Important Plant Areas.

i. Work cooperatively with federal, state, county, Tribal, and/or other landowners to control and manage existing noxious and invasive species, especially in areas with Plant Species of GCN.

j. Consult the most current Montana Noxious Weed Management Plan[20] when addressing noxious weed management relative to Plant Species of GCN and other native plants. Addressing actions that further strategies for non-native and native plant species will help maximize conservation efforts across organizations and jurisdictional boundaries.

Photo Credit: Connie Geiger

Photo 4-16. Autumn comes to the high country in the Seeley-Swan region of Montana. Periodic fires help to maintain diverse, shrub meadows and huckleberries!

k. Assess the cumulative risk of invasion by invasive non-native vascular plants for low, moderate, and optimally suitable habitats for all Plant Species of GCN.

6) Consider expanding the MNPS's Important Plant Areas Program (IPA)[21] as a tool towards a more comprehensive, systematic approach to identify sites of outstanding rare and unique plant assemblages across Montana. A more comprehensive, systematic approach to identifying potential IPAs could be done by using the MTNHP botany database and stratifying the state by land ownership category, land management classification, National Vegetation classification plant community level, or other stratification.

7) Improve coordination between MNPS and MTNHP to jointly determine the best ways to disseminate IPA information, particularly for use in environmental reviews, project, planning, and other stewardship activities.

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[20] Montana Noxious Weed Management Plan (MDA 2017): https://agr.mt.gov/_docs/NWTF-docs/MT-Noxious-Weed-Management-Plan--Update-2017.pdf

[21] MNPS Important Plant Areas: https://mtnativeplants.org/important-plant-areas/

Protection and Restoration

8) Develop partnerships between federal, state, non-profit, or private organizations with at least one botanical garden, seed storage facility, or arboretum in the western US. Botanical gardens, arboretums, and seed storage facilities can support Plant Species of GCN through research on rare plant physiology and genetics, reintroductions into the wild, seed collecting and banking, and other topics geared toward preventing extinctions. Potential organizations to partner with include, but are not limited to:
    - State of Montana Arboretum, University of Montana, Missoula, Montana[22]
    - Rae Selling Berry Seed Bank, Portland State University, Oregon[23]
    - Denver Botanical Gardens[24]
    - Plant Germplasm Introduction Test and Research Unit, Pullman, Washington[25]
    - National Laboratory for Genetic Resource Preservation, Fort Collins, Colorado
    - Tribal seed storage facilities in Montana

9) Advocate, initiate, or participate in the development of a native plant restoration working group to provide guidance and support for native plant restoration and management, especially where projects involve Plant Species of GCN. Refer to Section 3, Protection and Restoration Conservation Objective, #5.

10) Promote the understanding and use of the Reserved Treaty Rights Lands Program (RTRL)[26], a funding program administered by the Bureau of Indian Affairs (BIA), between Montana's Tribes and landownerships outside of Tribal properties. The program includes a focus on federal, state, private and other lands where excluding fire has compromised the resiliency and health of priority Tribal natural resources. For example, RTRL is helping the Confederated Salish and Kootenai Tribes, The Nature Conservancy, and the MT/Dakotas Bureau of Land Management restore Common Camas (*Camassia quamash*) populations.

11) Identify historic and potential contemporary refugia for climate adaptation, migration, or potential persistence of target Plant Species of GCN.

12) Prioritize Plant Species of GCN that are on the margin of their range in Montana for conservation and restoration related projects. For example, sustainable seed collecting in populations at the margin of their range could help preserve the plant's genetic material for future planting or other projects.

13) Prioritize restoration or reforestation in buffer areas around Plant Species of GCN, where human activities have negatively impacted habitat. Restoring adjacent habitats can aid the target species' ability to disperse or expand, possibly avoiding in-breeding and other genetic-related problems.

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[22] State of Montana Arboretum: https://www.umt.edu/arboretum/

[23] Rae Selling Berry Seed Bank: https://www.pdx.edu/seed-bank/

[24] Denver Botanic Gardens: https://www.botanicgardens.org/

[25] Washington State University: https://www.ars.usda.gov/pacific-west-area/pullman-wa/plant-germplasm-introduction-and-testing-research/docs/facilities-pullman-seed-storage/

[26] Reserved Treaty Rights Lands Program (RTRL): https://www.bia.gov/sites/default/files/dup/assets/public/pdf/idc1-030969.pdf

Outreach and Education

Conservation Goal

Facilitate the stewardship of Plant Species of Greatest Conservation Need through education, outreach, and coordination.

Conservation Objectives and Actions

Photo Credit: Bruce Selyem

Photo 4-17. Giant Helleborine (Epipactis gigantea) *is a Plant Species of GCN that is fairly well studied and in need of a Montana Conservation Profile.*

1) Coordinate with the *Montana Native Plant Conservation Strategy*'s Strategy Stewards Committee to establish species-specific working groups that would develop and write the conservation profile for each of the remaining Plant Species of GCN. Refer also to Section 1, Box 1-2 and Section 3, Information Needs Conservation Objectives, #2 and #3. The following guidelines should be applied to develop and write each profile:
   a. The completed conservation profiles for five Plant Species of GCN serve as the template (see Appendix A).
   b. In developing the *Strategy*, we found that statewide species-specific working groups, meeting virtually or in person, are the best way to gather information, discuss needs, problems, and issues, formulate conservation objectives, and develop a useful conservation profile.
   c. The working group should include people who share a vested interest in the species, its habitats, or the lands where it resides, and offer a spectrum of perspectives that are relevant, such as from the areas of botany, management, culture, administration, regulation, education, research, agriculture, business (extractive industries, land developers, utilities, plant nurseries, etc.), conservation, and others.
   d. Members of the working group could come from, but are not limited to, the following individuals or organizations:
      - Private industry, businesses, consultants, landowners, retired individuals
      - Federal land management agencies
      - State land management agencies and other programs (MTNHP, etc.)
      - County planning departments; other cooperators
      - Tribal nations, including Elders, traditionalists, ethnobotanists, plant gatherers, biologists, cultural directors, and administrators
      - Non-government conservation organizations
      - Academic institutions
      - Conservation societies, clubs, landowner associations, and other groups

Outreach and Education

2) Develop a shared resource to identify and prioritize educational materials for Priority 2 Plant Species of GCN. Actions could include:

    a. Create shared lists on the Strategy's webpage that highlight developed materials and identify data gaps relevant to outreach and education. Sharing developed educational materials could further conservation efforts for the specific Priority 2 Plant Species of GCN. A potential template to use for sharing information on Priority 2 Plant Species of GCN can be found on the Strategy's web page.

    b. Identify which species most need educational materials.

    c. Compile a list of developed educational materials, identify the species, authors, and organizations, and provide full references or links.

3) Develop or share educational materials that address the ways in which over-collecting plants can harm wild populations of Plant Species of GCN, their close relatives, and other native plants. See also Protection and Restoration Conservation Objectives, #4 in this section.

4) On Tribal lands and other cultural sites, acknowledge and respect traditional protocols for handling plants, plant parts, and seeds, whether for management, personal Indigenous use, restoration, or the collection of herbarium specimens. Several Tribes are very concerned about the indiscriminate collection of cultural plants for commercial use by pharmaceutical, alternative medicine, and other industries. As an example, the promotion of Narrow-leaved Purple Coneflower (*Echinacea angustifolia*) in the 1990s led to potential over-collecting of wild populations and prompted a three-year moratorium on the harvest of wild medicinal plants on state lands for [MCA 77-1-136]: Bitterroot (*Lewisia rediviva*); Narrow-leaved Purple Coneflower; lady's slipper (all species of *Cypripedium*); Fernleaf Biscuitroot (*Lomatium dissectum*); osha (all species of Ligusticum); sundew (all species of *Drosera*); and Western Trillium or Beth Root (*Trillium ovatum*).

5) Promote the MNPS' IPA Program[21] to bring recognition to locations where there are outstanding rare and unique plant occurrences, including Plant Species of GCN. The goal of this program is to identify the most important sites for plant conservation across Montana using consistent criteria (MNPS 2023). An IPA is a recognition by MNPS. Ways to promote and expand the program include, but are not limited to:

    a. Ensure that information on Montana's IPA list is shared with Plantlife International[27]. Montana's IPA program is part of an international effort led by Plant Life International, who maintains a worldwide database. Contributing to a global database strengthens the network of IPAs, furthering conservation efforts at state, national, and international levels.

    b. Encourage inclusion by all landowners (federal, state, Tribal, private, local, and others) in the IPA assessment and nomination process. Seeking input and permissions by all landowners pertinent to the specific IPA fosters support and concerted effort to retain the integrity of the IPA designation.

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[27] Plantlife International IPAs: https://www.plantlife.org.uk/protecting-plants-fungi/important-plant-areas/

c. Continue to share IPA site maps and information with MTNHP for displaying in Map Viewer[28]. On the Map Viewer web page, partnering agencies and organizations can find IPA mapping and information for use in their environmental reviews, projects, planning efforts, and other stewardship activities. Access is password-protected.

d. Continue to write articles in the MNPS Kelseya newsletter on a specific IPA and the program.

e. Host MNPS field trips to an IPA, and consider co-hosting with other conservation organizations, such as the Audubon Society, Wild Montana, and others.

f. Consider creating a brochure to create awareness and further the IPA mission in Montana.

6) Arboretums and botanical gardens can showcase native plants, including rare species and culturally important plants, and provide educational experiences for the public. Potential organizations to partner with include, but are not limited to:

   - State of Montana Arboretum, University of Montana, Missoula, Montana[29]
   - Denver Botanical Gardens[30]

7) Fund efforts for MTNHP to revise Plant Species of GCN profiles on the Montana Field Guide. Current MTNHP standards update and expand known information on life history, ecology, wildlife-plant interactions, identification, biological characteristics, economics, management, threats, taxonomy, and other interesting information; create links to the Strategy and other online information; and improve readability.

8) Support the development of species-specific conservation assessments produced by federal agencies. Link existing conservation assessment documents in the *Strategy's* webpage, Montana Field Guide species' profile, and other important places. The USFS has produced species conservation assessments for many plants in Region 1 to provide a sound scientific foundation for management. The USFWS develops status reports for plants to document conservation status and inform listings. These documents are extremely useful for making conservation decisions and informing research.

9) Consult the most current Montana Noxious Weed Management Plan[31] when addressing noxious weed educational efforts relative to Plant Species of GCN and other native plants. Addressing actions that further strategies for non-native and native plant species will help maximize conservation efforts across organizations and jurisdictional boundaries.

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[28] MTNHP Map Viewer: https://mtnhp.org/mapviewer/

[29] State of Montana Arboretum: https://www.umt.edu/arboretum/

[30] Denver Botanic Gardens: https://www.botanicgardens.org/

[31] Montana Noxious Weed Management Plan (MDA 2017): https://agr.mt.gov/_docs/NWTF-docs/MT-Noxious-Weed-Management-Plan--Update-2017.pdf

Policy and Regulation

Conservation Goal

Improve conservation of Montana's Plant Species of GCN through public participation and implementation of existing policies and regulations in cooperation with public land managers, private landowners, and other interested stakeholders.

Conservation Objectives

1) Integrate Plant Species, Unique Habitats, and Plant Communities of GCN into the next major revision (year 2025) of the Montana State Wildlife Action Plan (SWAP)[32] (Refer to Section 1, Need for a Statewide Native Plant Conservation Strategy, #3). As with all SWAPs, the Montana SWAP addresses eight required elements laid out by the US Congress, is updated every 10 years, and also serves as a funding mechanism whereby potential sources of federal funding can be appropriated towards conservation for species and habitats determined to be of GCN.
2) Through partnership and working collaboratively with MFWP, develop projects to ensure that approved Congressional funding for plants, such as passage of RAWA[33], is allocated and used on Plant Species of GCN. Refer also to Section 1, Need for the Strategy, #3.
3) Adhere to State of Montana laws governing the regulation of wildcrafting [MCA-76-10[34]] of Plant Species of GCN. This law governs the collection, harvesting, and removal of uncultivated plants and plant parts for the purpose of selling, trading, or exchanging the material for profit. Refer also to Section 3, Policy and Regulation Conservation Objective, #3.

Photo Credit: Tara Luna

Photo 4-18. Looking through the branches of a Whitebark Pine (Pinus albicaulis) *snag to a valley of Quaking Aspen* (Populus tremuloides) *communities in Montana.*

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[32] State Wildlife Action Plans (SWAP): https://www.fishwildlife.org/afwa-informs/state-wildlife-action-plans

[33] See Acronyms and Resources sections of the *Strategy*.

[34] MCA-77-10: https://leg.mt.gov/bills/mca/title_0760/chapter_0100/part_0010/sections_index.html

Policy and Regulation

4) Acknowledge and adhere to Tribal laws, ordinances, regulations, and policies, and protect TK of plants, including Plant Species of GCN, as the intellectual property of Tribal nations and individual Tribal members, including seeds, propagules and other plant parts occurring on Tribal jurisdictional lands. Refer also to Section 3, Policy and Regulation Conservation Objective, #4.

5) Through federal and state agency collaboration, continue to expand the Montana Natural Area System[35] by identifying and nominating existing and potential natural area sites to the board of land commissioners [MCA 79-12-104(1)] for possible designation, in accordance with MCA 76-12, the Montana Natural Areas Act of 1974. A natural area system coordinates the management of individual areas toward common goals that promote recreation, education, research, aesthetic enjoyment, and the unpredictable utility of individual species (Roush in Loope and Bird 1986).

6) Support state legislation that addresses Montana native plant conservation and threats imposed by noxious weeds and invasive species. Examples of past legislative efforts in Montana include, but are not limited to:
   - Montana House Bill 410 - introduced in 2021 - would have provided state policy to seed or plant native pollinator-friendly plants.
   - Montana House Judiciary Bill 17 - signed into law in 2021 - permanently establishes a Montana Noxious Weed Awareness Week in the first full week of June each year.

7) Work with federal agencies to help private landowners get compensation for their land protection actions through the USFWS recovery crediting system (Tollefson 2008) and/or other mechanisms.

8) Work with the Montana Department of Transportation and the US Army Corps of Engineers to revise goals and credits when a Plant Species of GCN is found and the population can be protected at a wetland mitigation site or bank. Consider modifying engineering designs or water management systems to ensure persistence when a Plant Species of GCN is found in wetland mitigation sites and banks.

9) Contact local federal, state, county, and city agencies and determine the best ways to comment on proposed projects and planning efforts. Review and comment on issues related to the biodiversity and health of native plants, native plant communities, and Plant Species of GCN.

10) Recognize, become informed, and adhere to Tribal policies, laws and regulations that protect, conserve or manage native plants and vegetation, including Plants of GCN. Also recognize and understand that each Tribe has its own set of laws and regulations.

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[35] A natural area system contains an integrated group of areas which in their entirety protect representative examples of all the state's natural systems and guarantees the continued existence of the full array of the state's biotic diversity (Roush in Loop and Bird (eds.) 1986).

REFERENCES

Anderson, Jacey. 2020. "Public Health, Economic Well-Being, and Mining in Montana." - (PhD thesis, Department of History and Philosophy, Montana State University, Bozeman, MT.) https://www.montana.edu/stes/blog/montana-mining.html [Accessed 26 March 2024]

Comer, Patrick, Don Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, K. Snow, and J. Teague. 2003. Ecological Systems of the United States: A Working Classification of US Terrestrial Systems. NatureService, Arlington, VA.

Edmo, T. 2024. Personal Communication. Climate Change Coordinator. Blackfeet Environmental Office. Blackfeet Nation. Browning, MT.

Elzinga, Caryl L., Daniel W. Salzer, and John W. Willoughby. 1998. Measuring and Monitoring Plant Populations. BLM Technical Reference 1730-1. Bureau of Land Management, National Business Center, Denver, CO. https://www.ntc.BLM.gov/krc/system/files/legacy/uploads/3342/technical%20reference.pdf

Fertig, Walter, Rick Black, and Paige Wolken. 2005. *Rangewide Status Review of Ute Ladies'-Tresses (Spiranthes diluvialis).* September 30th. Prepared for the US Fish and Wildlife Service and Central Utah Water Conservancy District.

Glenn, Mike. 2021. Interview with Mike Glenn. Vegetation Ecologist, Montana Department of Environmental Quality, Helena, MT. June 25th. Conducted by Andrea Pipp, Montana Natural Heritage Program, Helena, MT. -

Given, David R. 1994. *Principles and Practice of Plant Conservation*. Portland, OR: Timber Press. 292 pp.

Hansen, A., R. Knight, S. Powell, K. Brown, P. Gude, and K. Jones. 2005. "Effects of Exurban Development on Biodiversity: Patterns, Mechanisms, and Research Needs." Ecological Applications 15(6): 1893-1905.

Lesica, Peter. 1999. "Effects of fire on the demography of the endangered, geophytic herb *Silene spaldingii* (Caryophyllaceae)." *American Journal of Botany* 86(7): 996-1002.

Lesica, Peter, and Elizabeth Crone. 2017. "Arctic and boreal plant species in decline at their southern range limits in the Rocky Mountains." *Ecology Letters* 20(2): 166-74.

Lesica, Peter, and J. Stephen Shelly. 1996. Competitive effects of Centaurea maculosa on the population dynamics of *Arabis fecunda*. Bulletin of the Torrey Botanical Club 123(2):111-121.

Lesica, Peter, Matt T. Lavin, and Peter F. Stickney. 2022. *Manual of Montana Vascular Plants*, 2nd Edition. Fort Worth, TX: BRIT Press.

Loop, Donna. and Joan Bird (eds.). 1986. Montana natural areas conference proceedings. October 14-16. The Nature Conservancy, Big Sky Field Office. Helena, Montana. 159 p.

Longknife, Jr., Dennis. 2024. Personal Communication. Environmental Protection Department, Fort Belknap Indian Community, Harlem, MT.

Master, L. L., D. Faber-Langendoen, R. Bittman, G. A. Hammerson, B. Heidel, L. Ramsay, K. Snow, A. Teucher, and A. Tomaino. 2012. *NatureServe Conservation Status Assessments: Factors for Evaluating Species and Ecosystem Risk*. NatureServe, Arlington, VA.

Montana Invasive Species Council (MISC). 2024. Website's About Us webpage. https://invasivespecies.mt.gov/misc/about-us [Accessed April 2024]

Montana Department of Agriculture (MDA). 2017. Montana Noxious Weed Management Plan. MDA, Helena, MT. https://agr.mt.gov/_docs/NWTF-docs/MT-Noxious-Weed-Management-Plan--Update-2017.pdf

Montana Department of Environmental Quality (MTDEQ). 2024. Mining program overview. Helena, MT. https://deq.mt.gov/mining/index [Accessed 26 March 2024]

Montana Invasive Species Council (MISC). 2024. Montana Invasive Species Council Charter. Helena, MT. https://invasivespecies.mt.gov/misc/ [Accessed 26 March 2024]

Montana Native Plant Conservation Strategy-Criteria, Species, and Habitats Subcommittee. 2021. Meetings, document review, and electronic mail correspondences. February 3 to March 31. Available from Andrea Pipp, Botanist, Montana Natural Heritage Program, Helena, MT.

Montana Natural Heritage Program (MTNHP). 2024a. Queries of Species Snapshot app. Helena, MT. https://mtnhp.org/SpeciesSnapshot/?Vector=&Species=&Rank= [Accessed 22 March 2024]

Montana Natural Heritage Program (MTNHP). 2024b. Data queries from the MTNHP Botany Database from 2020 to 2024. Helena, MT.

Montana Natural Heritage Program (MTNHP). 2024c. Query of the Ecological Systems database. March 22nd. Helena, MT.

Montana Natural Heritage Program (MTNHP). 2024d. Data analysis of species, land ownership, and ecological systems stored in the MTNHP databases. April. Helena, MT.

Montana Natural Heritage Program (MTNHP). 2021. Montana Climate Change Vulnerability Index (CCVI) study. Prepared by Scott Mincemoyer, Helena, MT. Prepared for MTNHP, Helena, MT.

Montana Natural Heritage Program (MTNHP) Threat Assessment. 2021. State Threat Score Assignment and Assessment of Reported Threats from 2006 to 2021 for State-listed Vascular Plants. Botany Program, MTNHP, Helena, MT.

Montana's State Wildlife Action Plan (Montana's SWAP). 2015. Montana Fish, Wildlife & Parks, 1420 East Sixth Avenue, Helena, MT 59620. 441 pp.

Montana Weed Control Association (MWCA). 2024. Website. https://www.mtweed.org/

Natural Resources Conservation Service (NRCS). 2024. Information on Montana-Bridger Plant Materials Center. https://www.nrcs.usda.gov/plant-materials/mtpmc [Accessed 26 March 2024]

NatureServe. 2016. Guidelines for Using the NatureServe Climate Change Vulnerability Index. June 1st. Release 3.02. Arlington, VA. 65 pages. https://www.natureserve.org/sites/default/files/guidelines_natureserveclimatechangevulnerabilityindex_r3.02_1_jun_2016.pdf

NatureServe - Explorer. 2024. NatureServe Explorer. NatureServe, Arlington, VA. https://explorer.natureserve.org/

Neely, Betsy, Susan Panjabi, Eric Lane, Paige Lewis, Carol Dawson, Andrew. Kratz, Brian Kurzel, Tim Hogan, Jill Handwerk, Sarada Krishnan, Jennifer Neale, and Nicola Ripley. 2009. *Colorado Rare Plant Conservation Strategy*. Developed by the Colorado Rare Plant Conservation Initiative. The Nature Conservancy, Boulder, Colorado. 117 pp.

Rogers, P.C. 2017. Guide to Quaking Aspen ecology and management with emphasis on Bureau of Land Management Lands in the Western United States. Logan, UT: Western Aspen Alliance, Wildland Resources Department and Ecology Center, Utah State University. https://western-aspen-alliance.org/files/AspenFieldGuide_050817_final4.pdf [Accessed 8 March 2023]

Roush, Jon. 1986. "A Natural Area System for Montana: Making the Vision A Reality". *In* Loop, Donna.; and Joan Bird (eds.). 1986. Montana Natural Areas Conference Proceedings. October 14-16. The Nature Conservancy, Big Sky Field Office. Helena, Montana. 159 p.

Scarlet Ammannia Recovery Team. 2008. *Recovery strategy for the Scarlet Ammannia* (Ammannia robusta) *in British Columbia and Ontario*. Peterborough, ON: Prepared for the British Columbia Ministry of Environment, Victoria, BC, and the Ontario Ministry of Natural Resources. 20 pp.

Status of Tribes and Climate Change Working Group (STACCWG), Marks-Marino, D. (ed.). 2021. Status of Tribes and Climate Change Report, Institute for Tribal Environmental Professionals, Northern Arizona University, Flagstaff, AZ.

Stein, Bruce A., and Kelly Gravuer. 2008. Hidden in Plain Sight: The Role of Plants in State Wildlife Action Plans. NatureServe, Arlington, Virginia. 28 pp.

Stucki, Devin, and Thomas Rodhouse, J. Lyon, L. Grant. 2013. "Natural Resource Conservation in a Cultural Park: Evaluating the Importance of Big Hole National Battlefield to the Endemic Lemhi Penstemon (*Penstemon lemhiensis*)." *Natural Areas Journal* 33(1): 50-58.

Tollefson, C. 2008. Secretary Kempthorne announces new conservation mechamism for Threatened and Endangered Species. Press release. US Fish and Wildlife Service, Washinton, D.C.

United States Census Bureau. 2024. Quick Facts for Montana. https://www.census.gov/quickfacts/fact/table/MT/PST045223 [Accessed 25 March 2024]

US Fish and Wildlife Service (USFWS). 1992. Endangered and threatened wildlife and plants; final rule to list the plant *Spiranthes diluvialis* (Ute ladies' tresses) as a threatened species. Federal Register 57(12):2048-2054.

US Fish and Wildlife Service (USFWS). 2001. Endangered and threatened wildlife and plants; final rule to list the plant *Silene spaldingii* (Spalding's Catchfly) as a threatened species. Federal Register 66:51598-51606.

US Fish and Wildlife Service (USFWS). 2007. *Recovery Plan for* Silene spaldingii *(Spalding's Catchfly)*. US Fish and Wildlife Service, Portland, Oregon. xiii + 187 pages.

US Fish and Wildlife Service (USFWS). 2020. Post-delisting Monitoring Plan for Water Howellia (*Howellia aquatilis*). Helena, Montana. 33 pp.

U.S. Fish and Wildlife Service. 2021 (USFWS). 90-Day Finding Petition Review Form for *Physaria pachyphylla*. Federal Docket Number: FWS-R6-ES-2021-0117. Washington D.C.

US Fish and Wildlife Service (USFWS). 2022. Endangered and Threatened Wildlife and Plants; Threatened Species Status with Section 4(d) Rule for Whitebark Pine (*Pinus albicaulis*). 50 CFR Part 17. Federal Register 87(240):76882-76917. Washington D.C.

Whitlock, Cathy, Wyatt F. Cross, Bruce Maxwell, Nick Silverman, and Alisa A. Wade. 2017. 2017 Montana Climate Assessment. Bozeman and Missoula MT: Montana State University and University of Montana, Montana Institute on Ecosystems. 318 p. doi:10.15788/m2ww8w. https://live-mca-site.pantheonsite.io/sites/default/files/thumbnails/image/2017-Montana-Climate-Assessment-lr.pdf

Williams, Evelyn and Abigail White. 2017. Howell's Gumweed (Grindelia howellii) Genetic Diversity and Conservation Lab Report. National Forest Genetics Laboratory (NFGEL) Project #333. Prepared by Chicago Botanic Garden, Glencoe, Illinois under contract with NFGEL, Placerville, California. Prepared for Karen Stockmann, USFS Botanist, Lolo National Forest, Missoula, MT. https://archive.org/details/GrindeliahowelliiGenetics-MontanaMTNHP-USFS2018/mode/2up

World Wildlife Fund (WWF). 2023. Plowprint. https://files.worldwildlife.org/wwfcmsprod/files/Publication/file/6wlbsmxokc_PlowprintReport_2023_final.pdf?_ga=2.40396642.1303365568.1711488292-508164714.1711488292 [Accessed 26 March 2024]

SECTION 5

Unique Habitats of Greatest Conservation Need

SECTION 5
UNIQUE HABITATS OF GREATEST CONSERVATION NEED

UNIQUE HABITATS IN MONTANA

In various locations throughout Montana there are unique habitats that have formed under specific, uncommon environmental conditions. Unique habitats differ from most plant communities in that they occupy relatively small areas, have formed under unusual combinations of geology, soil chemistry, hydrology, and/or other factors, and typically support plant assemblages that are not common. These plant assemblages may be rare plant community associations or rare plant species, such as Plant Species of Greatest Conservation Need (see Section 4). In some situations, the specific plant species is not just rare in Montana but is restricted to occurring only in a particular unique habitat (see Section 4). To date, conservation efforts for these restricted rare plants have mostly focused on the species, and less on sustaining the unique habitat.

Unique Habitats are highlighted in the *Montana Native Plant Conservation Strategy*, hereafter the *Strategy*, because of their distinctive characteristics that typically are not included in plant community classifications such as the U.S. National Vegetation Classification (USNVC 2024). Unique habitats are priorities for conservation because they support rare elements (species and/or plant assemblages), along with unique physical components (uncommon combinations of geology, soils, hydrology, or other ecological characteristics); yet, have largely gone unnoticed in some vegetation classification systems.

Determining Unique Habitats of Greatest Conservation Need

The initial list of unique habitats for Montana was compiled by an ecologist and a botanist who each have more than 30 years of experience in conducting vegetation inventories throughout the state. Their proposed list was discussed with the Criteria-Species-Habitat Subcommittee (Montana Native Plant Conservation Strategy-Criteria-Species-Habitat Subcommittee 2021). Criteria used to identify and determine a 'unique habitat of greatest conservation need' in Montana includes the following elements: 1) spatially limited in Montana, 2) formed under unusual conditions or combinations of geology, hydrology, soils, and/or other ecological factors, 3) is habitat for at least one plant Species of Concern (SOC) or Potential Species of Concern (PSOC)[1] which is partially or entirely restricted to those conditions, and 4) may include at least one rare plant community (plant association, habitat type, or other). The subcommittee identified nine Unique Habitats of GCN[1] in Montana (Table 5-1).

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[1] Refer to the "Acronyms and Abbreviations" and "Glossary" sections in *Strategy*.

Table 5-1. Unique Habitats of Greatest Conservation Need (GCN) prioritized in the Montana Native Plant Conservation Strategy for Vascular Plant Species and Habitats of GCN.

Unique Habitat	General Location(s)	Associated Plant Species of GCN[1] and Uncommon Botanical Species & Vegetation Types	Conservation Profile or Habitat Strategy Developed?
Metamorphosed Limestone: Calcareous soils overlying limestone that were metamorphosed during the uplifting of adjacent mountain ranges.	West-central and Southwest Montana: • North and east flanks, Pioneer Mountains • Western foothills, Sapphire Mountains	• Sapphire Rockcress - *Boechera fecunda*	Conservation Profile: Appendix B in *Strategy*
Centennial Valley Sand Dunes: • Sand dunes deposited post-Pleistocene. • Includes other areas of sandy deposits that are not part of a dune system.	Southwest Montana: • Base of the east-west oriented Centennial Range towards the eastern extremity of Centennial Valley	• Painted Milkvetch – *Astragalus ceramicus* var. *apus* • Sand Wildrye – *Elymus flavescens* • Fendler Cat's-eye – *Cryptantha fendleri*	Conservation Profile: Appendix B in *Strategy*
Wooded Vernal Ponds[2]**:** • Formed by melting glacial ice deposits. • Depressional wetlands within forested areas that fill with water by spring and partially to fully dry by autumn.	Northwest Monana: • Swan Valley	Water Howellia - *Howellia aquatilis*	No
Obsidian Sands: • Eroded material from the rhyolite-dominated plateaus of Yellowstone National Park that has been water-sorted with the coarse-textured fraction (sands, with a large fraction of volcanic glass or obsidian) deposited in the West Yellowstone basin. • These sands are exceedingly nutrient poor, occur in a basin known for cold-air ponding, and combine with factors to produce a unique forest community.	Southwest Montana: • Yellowstone region	Unique Forest Community: Lodgepole Pine (*Pinus contorta*) is the long-term (climax) dominant and the undergrowth is characterized by Antelope Bitterbrush (*Purshia tridentata*) and bunchgrasses.	No
Bedrock Glades: Treeless sites where a thin soil mantle has formed over level to gently sloping bedrock. The areas covered with soil are typically interspersed with the exposed bedrock.	West-central and Northwest Montana: • East flank, Bitterroot Mountains • Kootenai National Forest • Glacier National Park	To be determined.	No

Table 5-1 (continued). Unique Habitats of Greatest Conservation Need (GCN) prioritized in the Montana Native Plant Conservation Strategy for Vascular Plant Species and Habitats of GCN.

Unique Habitat	General Location(s)	Associated Plant Species of GCN[1] and Uncommon Botanical Species & Vegetation Types	Conservation Profile or Habitat Strategy Developed?
Vernally Moist Cliffs: Gently sloping ledges found on steeper terrain or cliffs, in areas with high winter and spring precipitation, and typified by well-developed moss layers that are moist in spring and dry out by late summer.	West-central and Northwest Montana	• Sandweed - *Athysanus pusillus* • Scalepod - *Idahoa scapigera.*	No
Shale Barrens: Slopes with sedimentary rock that has eroded into thin, flat "flakes" that create a well-drained and unstable surface.	Central Montana: • Big Belt Mountains • Little Belt Mountains	• *Physaria klausii* - Divide bladderpod • Several *Cladonia* lichen species of limited distribution, under study (McCune 2022)	No
Peatlands [Fens][3]: Wetlands that accumulate organic matter at a rate that exceeds decomposition, resulting in an accumulation of permanently saturated peat.	Predominantly West-central and Northwest Montana: • Continental Divide, east & west sides at lower elevations	• Vascular Plants of GCN: *Carex tenuiflora; Drosera anglica; Drosera linearis; Eleocharis rostellata; Epipactis gigantea; Liparis loeselii; Lobelia kalmii; Mimulus primuloides; Ophioglossum pusillum; Petasties frigidus* var. *frigidus; Pinquicula macroceras; Scheuchzeria palustris; Trichophorum alpinum; Trichophorum cespitosum; Utricularia intermedia.* • Moss SOC/PSOC plants: certain species of *Spaghnum* and other genera • Lichen SOC: *Cetraria sepincola*	No
Bentonite Deposits: • Soils of Hydrothermally altered ash originating from the Yellowstone hotspot. Typically forms a shallow convex surface that extends from a few hundred to thousands of square meters. • These deposits constitute a horizontal "badland", evidently inimical to vegetation. Plants are often restricted to the periphery of deposits or exhibit low densities,	Southeast Montana: • Northern to southern state border in eastern edge of State.	Plants are often restricted to the periphery of deposits or exhibit low densities. • Bur Oak - *Quercus macrocarpa*	No

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[1] Used the "Search Field Guide" tool to find species profiles on the Montana Field Guide: https://fieldguide.mt.gov/default.aspx

[2] Wooded Vernal Ponds may also be represented as a plant community in other literature and classifications.

[3] Fens are a type of Peatlands, and both may also be represented as a plant community in other literature and classifications.

CONSERVATION GOALS & OBJECTIVES FOR UNIQUE HABITATS OF GREATEST CONSERVATION NEED

The *Strategy's* purpose is to promote the collective and coordination stewardship of Montana's Unique Habitats of GCN to ensure their viability and persistence now and into the future. To effectively conserve Unique Habitats of GCN requires a fusion of academic and pragmatic approaches to conservation problems, so that solutions are both innovative and realistic (Given 1994). Effective conservation also depends upon public attitudes, having good techniques that are cost-effective, and developing a range of approaches (Given 1994). Here in the Unique Habitats of GCN section of the *Strategy*, we present goals and over-arching objectives from four areas that are pillars of plant habitat conservation:

- Information Needs [Inventory, Monitoring, Research]
- Protection and Restoration
- Outreach and Education
- Policy and Regulation

Photo Credit: J. Stephen Shelly

Photo 5-1. Bent Flat Fen on the Flathead National Forest in Montana provides habitat for rare vascular and moss plants

The conservation objectives apply to most, if not all, nine Unique Habitats of GCN. They were developed by the Strategy's Core Team from 2021 to 2024 and are based on literature and professional expertise and field observations. In addition, generalized conservation objectives or actions from other strategies that could be pertinent to all, or most unique habitats were sought out, but not found. To-date, conservation profiles for the Centennial Valley Sand Dunes and Metamorphosed Limestone Unique Habitats of GCN have been completed (Appendix B).

Implementing conservation objectives is expected to enhance public awareness, develop a statewide Geographic Information System (GIS) data layer for unique habitats, and garner land stewardship support for these ecologically valuable habitats that harbor great biodiversity. Working within and across jurisdictional boundaries, these conservation objectives are voluntary measures intended to aid land managers, landowners, conservation practitioners, educators, and individuals who want to help sustain Unique Habitats of GCN across the Montana landscape.

Information Needs [Inventory, Monitoring, Research]

Conservation Goal

Improve scientific and cultural understandings of Montana's Unique Habitats of GCN through statewide coordination, inventory, monitoring, and research.

Conservation Objectives

1) Coordinate with the Montana Native Plant Conservation Strategy's Stewards Committee to establish a working group or subcommittee to address either all or specific Unique Habitats of GCN in Montana. A statewide working group could elevate public and agency awareness about the specific unique habitat, compile information, evaluate needs and resources, provide direction, and/or write the habitat-specific conservation profile.

    a. The formation of a working group to address one to all Unique Habitats of GCN could include conservation practitioners, landowners, ecologists, land managers, botanists, and others who work for, but are not limited to the following organizations:

    - Private industry, consultants, landowners, and retired individuals
    - Federal land management agencies
    - State land management agencies
    - Montana Native Plant Society
    - Montana Natural Heritage Program
    - Tribal Nations, such as Elders, traditionalists, ethnobotanists, plant gatherers, biologists, cultural directors, and administrators
    - Non-governmental conservation organizations
    - Academic researchers

    b. Recommended statewide topics for a Unique Habitats of GCN working group to address includes, but is not limited to:

    - Update the process for identifying and prioritizing Unique Habitats of GCN.
    - Review and refine the list of Unique Habitats of GCN.
    - Provide coordination and oversight to compile information and monitor conservation activities relative to Unique Habitats of GCN.
    - Assist efforts to implement conservation activities relative to Unique Habitats of GCN. Assistance could be provided by writing proposals, identifying funds or funding conservation actions, collaborating on proposals or projects, creating or implementing actions that support a conservation objective, and many others.
    - Provide direction on content development and formats (peer-reviewed publications, unpublished reports, online, etc.) for sharing information, data, and mapping.
    - Create a process to evaluate, determine, and recommend sites that are in need of monitoring or restoration for each type of unique habitat.

Information Needs [Inventory, Monitoring, Research]

2) Conduct literature searches and inquire with the network of agency botanists and ecologists to compile and centralize known information on each Unique Habitat of GCN, including hardcopy maps, published reports, ecological field survey forms, photographs, and current project information.

3) Develop a statewide map for each Unique Habitat of GCN using existing information and identify areas that have potential unique habitat. Use, as appropriate, GIS data layers, remote sensing techniques (such as LiDAR), and other mapping tools to identify and map known and potential locations of unique habitats.

4) Initiate field inventories and data collection efforts at known sites for Unique Habitats of GCN. Developing protocols and identifying data collection needs would improve our knowledge about the various physical, abiotic, and biotic elements of each unique habitat, and their ecological condition. Data collection efforts could include, but are not limited to:
   - Mapping or confirming geologic features
   - Measuring, mapping, or characterizing hydrological features
   - Mapping or confirming soil types and profiles
   - Conducting plant inventories to acquire plant population density, distribution, and size data; habitat attributes and condition; threat information; and other data.
   - Evaluating the presence, condition, and extent of land occupied by the particular unique habitat.
   - Develop baseline studies, if not previously established, to monitor for changes in vegetation, land use, population trends (increasing, decreasing, or stable) of non-native plants, Plant Species of GCN, animal species, or other management targets.
   - Conduct assessments in and near the unique habitat to identify and document any existing or potential threats.

Photo Credit: Andrea Pipp

Photo 5-2. Frenchman Breaks, a Shale Barrens Unique Habitat of GCN, occurs in northeastern Montana where large contiguous acres are managed by the MT/Dakotas BLM.

Protection and Restoration

Conservation Goal

Secure on-the-ground, site specific habitat protection for and/or restoration of Unique Habitats of Greatest Conservation Need plant on public and private lands.

Conservation Objectives

1) Evaluate the protection status at known locations for each type of unique habitat. Identify locations where protection or recognition may be warranted and the level (conservation easement, IPA, change in a management action, etc.) of protection that could aid its persistence. Prioritize the need for protection at each identified location for a given unique habitat type.
2) Evaluate the need for restoration at known locations for each type of unique habitat. Identify locations where restoration may be warranted and the level of restoration that is needed to aid its persistence. Prioritize the need for restoration at each identified location.
3) Develop a monitoring plan to track the presence and invasiveness of non-native plants and animals, including state-designated invasive, noxious, and regulated species, in locations of unique habitats. Work in concert with the land management agency(-ies), private landowner(s), and other stakeholders to create a plan that can be effectively implemented to guide management actions, prevent or reduce negative impacts from non-native species, and be compatible with associated rare plants and animals. On a state-wide basis, non-native species are one of the most common vectors that have the potential to negatively impact unique habitats (MTNHP Threat Assessment 2021).

Photo Credit: Dee Blank

Photo 5-3. In the rain shadow of the Pryor Mountains is an arid red desert with high biodiversity. This unique part of Montana is habitat for Thickleaf Bladderpod (Physaria pachyphylla) *and numerous other rare plants.*

Protection and Restoration

4) Evaluate the Montana Native Plant Society's (MNPS) Important Plant Area (IPA) Program[2] for its ability to identify or prioritize the botanical value of sites relative to the type of unique habitat. Where there is potential for nominating a unique habitat site as an IPA, convene a meeting or working group led by MNPS members and invite pertinent stake holders. Use collaboration among all stakeholders to discuss, define (including its boundaries), and determine if an official IPA can be nominated to the MNPS. The goal of the Montana Native Plant Society's IPA Program is to identify the most important sites for plant conservation across Montana using consistent criteria (MNPS 2024). Important Plant Area sites exhibit exceptional populations of one or more globally rare plants or uncommon or threatened plant assemblages in Montana (MNPS 2024). An IPA is an informal recognition by the MNPS.

Outreach and Education

Conservation Goal

Facilitate the stewardship of Montana's Unique Habitats of Greatest Conservation Need through education, outreach, and coordination.

Conservation Objectives

1) Initiate coordination with the *Montana Native Plant Conservation Strategy's* Stewards Committee (refer to Section 1, Box 1-2) or the Unique Habitats Working Group (see Information Needs, Conservation Objective #1) to establish one or more working groups that can develop and write the conservation profile for each Unique Habitat of GCN (see Appendix B for templates). In the process of developing this Strategy, we have found that working groups, meet virtually or in-person, are the best way to gather information, discuss needs, problems, and issues, formulate conservation objectives, and develop a useful conservation profile. The Working Group should include people with an array of knowledge of or responsibility for the unique habitat or the property, including biological, administrative, regulatory, specific conservation-focus (Audubon, Penstemon Society, etc.), landowner, and other interests.

2) Revise profiles on the Montana Field Guide[3] for each Plant Species of GCN and other native plant species that associate with a Unique Habitat of GCN. Using the newest MTNHP standards will update and expand known information on the plant species' life history, ecology, wildlife-plant interactions, identification, taxonomy, range, habitat, biology, economics, management, threats, taxonomy, and other interesting facts; improve readability; and link to other online resources. Cross-walking plants, animals, and habitats on the Montana Field Guide will elevate awareness of Montana's Unique Habitats of GCN.

3) Revise profiles on the Montana Field Guide[3] for each animal Species of Concern that occurs within a Unique Habitat of GCN. Cross-walking plants, animals, and habitats on the Montana Field Guide will elevate awareness of Montana's Unique Habitats of GCN.

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[2] MNPS Important Plants Areas Program: https://mtnativeplants.org/important-plant-areas/

[3] Montana Field Guide: https://fieldguide.mt.gov/

Outreach and Education

4) Work with land trusts and conservation organizations to inform them about Unique Habitats of GCN and engage in discussions about conservation of Montana's Unique Habitats of GCN. Many people involved in conservation are not aware of some of the rarer habitats in Montana.

5) Extend invitations to members of Tribal nations in Montana to engage in conversations, listen to their knowledge, and hear their concerns and needs regarding the Unique Habitat of GCN. For any cultural plant associated with these unique habitats consult the appropriate approvals from Tribal leaders or Tribal Liaisons in respectful ways for how to incorporate traditional or indigenous uses and management, including the action to not convey.

6) Consult with educators or educational staff at Montana Fish, Wildlife and Parks, Helena-Lewis and Clark National Forest, Montana Native Plant Society, or other organizations to develop an educational presentation on Unique Habitats of GCN.

7) Support the development and use of specific conservation assessments that address Unique Habitats of GCN that are produced by land management agencies, non-governmental organizations, academia, and other groups. The U.S. Forest Service produces General Technical Reports that provide information with a sound scientific foundation for management. The U.S. Fish and Wildlife Service develops status reports for plants to document conservation status and inform listings. These documents are extremely useful for providing information across land management jurisdictions, assisting with conservation decisions, and informing on current research. A few examples include:
   - *Peatlands on National Forests of the Northern Rockies: Ecology and Conservation* (Chadde et al. 1998).
   - *Fens and Their Rare Plants in the Beartooth Mountains, Shoshone National Forest, Wyoming* (Heidel et al. 2017)
   - *Restoration Guidelines for Wetlands of the Western Prairie Pothole Region* (Luna et al. 2012)

Photo Credit: Matthew Stewart

Photo 5-4. Junipers, pines, and Burr Oaks (Quercus macrocarpa) *in southeast Montana. Burr Oak, a Plant Species of GCN, often occurs at the periphery of Bentonite Deposits, a Unique Habitat of GCN.*

Photo Credit: Matthew Stewart, 406 Stewart Photography

Photo 5-5. Burr Oak male flowers are borne in a drooping catkin; when mature they release pollen.

Policy and Regulation

Conservation Goal

Work with public land managers, private landowners, and other interested stakeholders, to improve the conservation of Montana's Unique Habitats of Greatest Conservation Need through existing policies and regulations.

Conservation Objectives

1) State and federal agencies are encouraged to continue to build the Montana Natural Area System by identifying and nominating existing and potential natural area sites to the board of land commissioners [MCA 79-12-104(1)] for possible designation, in accordance with the Montana Natural Areas Act of 1974 (MCA 76-12). Areas that include Unique Habitats of GCN are especially encouraged for nomination. A natural area system contains representative examples of all of the state's natural habitats and guarantees the continued existence of the full array of the state's biotic diversity (Roush *in* 1986 Montana Natural Areas Conference proceedings). A natural area system can coordinate the management of individual areas toward common goals which are a benefit to society for recreation, education, research, aesthetic enjoyment, and the unpredictable utility of individual species (Roush in 1986 Montana Natural Areas Conference proceedings).

2) State and federal agency resource professionals should examine if their agencies' policies, regulations, or other administrative rules govern any of the nine identified Unique Habitats of GCN (Table 6-1). Findings should be shared with the *Montana Native Plant Conservation Strategy* Stewards Committee, Unique Habitats of GCN working group, or partnership for the *Strategy*.

REFERENCES

Chadde, S.; J. Shelly; R. Bursik; R. Moseley; A. Evenden; M. Mantas; F. Rabe; and B. Heidel. 1998. Peatlands on national forests of the northern Rocky Mountains: ecology and conservation. General Technical Report RMRS-GTR-11. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 75 p.

Given, David R. 1994. *Principles and Practice of Plant Conservation. Portland, OR: Timber Press 292* pp.

Heidel, B.; W. Fertig; S. Mellmann-Brown.; K. Houston; and K. Dwire. 2017. Fens and Their Rare Plants in the Beartooth Mountains, Shoshone National Forest, Wyoming. General Technical Report RMRS-GTR-369. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 110 p.

Luna, T.; L. Vance; and M. Hart. 2012. *Restoration Guidelines for Wetlands of the Western Prairie Pothole Region*. Report to the U.S. Environmental Protection Agency. Montana Natural Heritage Program, Helena, MT. 123 pp. plus appendices.

McCune, Bruce. 2022. Field studies and genetic analysis of *Cladonia* lichens on acid-shale habitats. Unpublished study in progress. Information available for Andrea Pipp, Botanist, Montana Natural Heritage Program, Helena, MT.

Montana Native Plant Conservation Strategy - Criteria-Species-Habitat Subcommittee. 2021. Meeting notes and recordings from February 3 to March 31. Available from Andrea Pipp, Botanist, Montana Natural Heritage Program, Helena, MT.

Montana Native Plant Conservation Strategy. 2024. Comments provided on draft components of the developing Strategy by various members of the partnership through meetings, electronic mail, and tracked changes. Meetings and correspondences obtained from January 2020 through March 2024. Compiled by Andrea Pipp, MTNHP, Helena, Montana.

Montana Native Plant Society (MNPS). 2024. Important Plant Area. Missoula, MT. https://mtnativeplants.org/important-plant-areas/ [20 January 2024].

Montana Natural Heritage Program (MTNHP) Threat Assessment. 2021. State Threat Score Assignment and Assessment of Reported Threats from 2006 to 2021 for State-listed Vascular Plants. Botany Program, Montana Natural Heritage Program, Helena, Montana.

Roush, Jon. 1986. A Natural Area System for Montana: Making the Vision a Reality. In: Montana Natural Areas Conference Proceedings, October 14-16. Billings, Montana [Loop and Bird (eds.), The Nature Conservancy, Helena, MT].

US National Vegetation Classification System (USNVC). 2024. Information about USNVC. https://usnvc.org/ [5 March 2024]

SECTION 6

Plant Communities of Greatest Conservation Need

SECTION 6

PLANT COMMUNITIES OF GREATEST CONSERVATION NEED

PLANT COMMUNITIES IN MONTANA

Numerous, widespread plant communities characterize the terrestrial, riparian, and aquatic systems within the Rocky Mountain and Great Plains regions of Montana. Prominent examples of major plant communities include coniferous forest, temperate grassland, riparian forest, sagebrush steppe, alpine, and freshwater marsh. Each major plant community is composed of smaller, interconnected vegetation types, that go by many names. At the international, national, regional, and state scales, many different approaches have been used to define and classify these plant communities and vegetation types. Various approaches emphasize different criteria relative to the vegetation, such as plant species composition, dominant plant species, structure, geology, soils, climate pattern, topography, disturbance, landform, and site history. Many national, regional, and state level classification systems have been used in Montana to describe, classify, categorize, and/or map our state's vegetation (Box 6-1). Montana's Tribes also have ways of knowing the plant communities on their ancestral lands and the reservation lands they manage (Box 6-1).

Although prominent in Montana, some plant communities are of concern to land managers across the state because of natural or anthropogenic stressors and/or a lack of protection or regulation. Indigenous tribal members have also expressed great concern for some of their important floral and physical places, which face the same natural or anthropogenic stressors and/or a lack of protection or regulation. In the process of

Box 6-1. Pertinent ecological, soil, and vegetation classification systems and knowledge used in Montana to define, classify, and map plant communities, vegetation types, and flora places.

- Soil Surveys – USDA, Natural Resources Conservation Service: https://websoilsurvey.nrcs.usda.gov/app/
- Forest Habitat Types of Western Montana - Pfister et al. 1977
- Classification of Wetlands and Deepwater Habitats of the United States - Cowardin et al. 1979
- Wetland and Riparian Mapping of Montana: https://mtnhp.org/mapviewer/
- Grassland and Shrubland Habitat Types of Western Montana - Mueggler and Stewart 1980
- Classification and Management of Montana's Riparian and Wetland Sites - Hansen et al. 19952012, 2022: Manual of Montana Vascular Plants—Lesica
- Ecological Site Descriptions - USDA, Natural Resources Conservation Service: https://www.nrcs.usda.gov/getting-assistance/technical-assistance/ecological-sciences/ecological-site-descriptions
- Ecoregions - Environmental Protection Agency: https://www.epa.gov/eco-research/ecoregions
- LANDFIRE – USDI-Forest Service: https://landfire.gov/index.php
- NatureServe's Ecological Systems of Montana: https://fieldguide.mt.gov/displayES_LCLU.aspx
- U.S. National Vegetation Classification: https://usnvc.org/
- Floral places, physical sites, and landscapes of cultural, spiritual, and traditional significance and importance – Indigenous Tribal Communities in Montana

developing the concept for a Montana Native Plant Conservation Strategy, members of the larger partnership representing various federal and state agencies suggested a voluntary, non-regulatory approach could aid efforts to conserve certain plant communities.

Determining Plant Communities of Greatest Conservation Need

A large partnership of biologists, ecologists, and botanists working for or retired from federal and state land management agencies, non-government organizations, and academic herbaria met in April 2019 to discuss the concept of a Montana Rare Plant Conservation Strategy[1]. From the discussion came a list of commonly occurring plant communities which land managers across several organizations expressed significant concern for their persistence. This list was further refined in 2021 by the Criteria-Species-Habitat Subcommittee (Montana Native Plant Conservation Strategy-Criteria-Species-Habitat Subcommittee 2021). Criteria used to determine a 'plant community of greatest conservation need' included the following elements:

- Fits the definition of a plant community: widespread and common in Montana; composed of smaller vegetation types; and provides ecosystem services; AND
- Is facing a significant threat that can be identified, and one that is generally shared by multiple land managers in different portions of Montana.

The subcommittee, with agreement by the larger partnership on April 12, 2021, proposed five plant communities for inclusion in the *Montana Native Plant Conservation Strategy*, hereafter *Strategy*, as Plant Communities of Greatest Conservation Need (GCN). Over the course of developing the Strategy, there has been debate as to whether some vegetation types should be unique habitats or plant communities. Therefore, readers of the *Strategy*, should also consult Section 5-Unique Habitats of Greatest Conservation Need. In the Strategy five Plant Communities of Greatest Conservation Need (GCN) are recognized (Table 6-1).

Table 6-1. Montana Plant Communities of Greatest Conservation (GCN) Need prioritized in the Montana Native Plant Conservation Strategy for Vascular Species and Habitats of GCN

Plant Community	General Locations in Montana	Conservation Profile Developed?
Cottonwood riparian forest communities	Throughout Montana and associated with large rivers and smaller stream systems	No
Prairie pothole communities	North-central to northeast Montana	No
Quaking Aspen communities	Throughout most of Montana in scattered locations.	Conservation Profile: Appendix C in *Strategy*
Sagebrush communities	Predominantly in southwest, south-central, north-central, northeast, and southeast Montana	No
Western (Montane) grassland communities	Western Montana	No

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[1] This meeting laid the groundwork for planning and development of a *Montana Native Plant Conservation Strategy: Species and Habitats of Greatest Conservation Need*. Almost 35 organizations were invited; 22 people attended, representing retired and working professionals for federal and state government, NGOs, and academic herbaria organizations (see Table 1, page *iii*).

CONSERVATION GOALS & OBJECTIVES FOR PLANT COMMUNITIES OF GREATEST CONSERVATION NEED

The purpose is to promote the collective and coordination stewardship of Montana's Plant Communities of GCN to ensure their viability and persistence now and into the future. To effectively conserve Plant Communities of GCN requires a fusion of academic and pragmatic approaches to conservation problems, so that solutions are both innovative and realistic (Given 1994). Effective conservation also depends upon public attitudes, having good techniques that are cost-effective, and developing a range of approaches (Given 1994). Here in the Plant Communities of GCN section of the *Strategy*, we present goals and and over-arching objectives from four areas that are pillars of plant community conservation.

- Information Needs [Inventory, Monitoring, Research]
- Protection and Restoration
- Outreach and Education
- Policy and Regulation

The conservation objectives were developed by the members of the larger partnership from 2021 to 2024 and are based on literature and professional expertise and experiences. In addition, conservation objectives or actions from other strategies[2] were reviewed and cross-walked with this *Strategy* to relay the idea that collaboration across multiple land ownerships can often advance several management goals at one time.

Photo Credit: Dee Blank

Photo 6-1. A Prairie Pothole Plant Community of GCN, on the Bandy Ranch in the Blackfoot Valley, Montana.

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[2] Montana Forest Action Plan (Montana Forest Action Advisory Council 2020): https://dnrc.mt.gov/_docs/forestry/Montana_Forest_Action_Plan_12.22.2020.pdf
Montana State Wildlife Action Plan (MFWP 2015): https://fwp.mt.gov/binaries/content/assets/fwp/gisresources/docs/swap/70169.pdf

Information Needs [Inventory, Monitoring, Research]

Conservation Goal

Improve our scientific and cultural understanding of plant communities, their distributions, and classifications through inventory, monitoring, and research.

Conservation Objectives

1) Establish one or more statewide subcommittees or working groups to guide and develop the process for addressing one to all Plant Communities of GCN. Elements include, but are not limited to:
    a. Review the 2024 Plant Communities of GCN list and criteria to make recommendations on how to improve the process, better define the plant community in need of conservation, and substantiate listings with data.
    b. Collaborate with the Montana Forest Action Advisory Council and Montana's State Wildlife Action Plan team, and others who helped developed statewide strategies to consolidate designated communities in need of conservation, strengthen common goals, and develop synergy to improve the health and ecological functions of prioritized plant communities.
    c. A statewide subcommittee or working group should be composed of people who represent the diversity of organizations across the state that engage, directly and indirectly, with the specific plant community. Examples of engagement include ecology, education, research, policy, and administration. Potential organizations to represent include, but are not limited to:
        - Private industry, such as nurseries, consultants, private foresters, and Montana Nursery and Landscape Association
        - Private landowners
        - Federal land managers, such as BIA, BLM, NPS, and USFS[3]
        - State land managers, such as MTFWP, MTDEQ, and MTDNRC[3]
        - Tribal Nations, such as Tribal colleges, Elders, traditionalists, plant gatherers, ethnobotanists, biologists, cultural directors, and administrators
        - Non-governmental conservation organizations, such as TNC, Montana Audubon, MNPS[3]
        - Academic researchers
2) In collaboration with ecologists working for the Montana Natural Heritage Program, NatureServe, LANDFIRE program, and University of Montana's Spatial Analysis Lab, continue to map existing vegetation communities in Montana using the U.S. National Vegetation Classification system (USNVC) (see Box 6-1). The USNVC provides a national standard and comprehensive system for all vegetation types in the US and is paralleled by the Canadian and International systems for vegetation classification. Conforming to the USNVC ensures greater efficiency and inter-agency communication across jurisdictional boundaries and with other ecological organizations. These efforts result in improved and more accurate global and state ranks for plant communities.

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[3] Refer to the "Acronyms and Abbreviations" section at the end of the *Strategy*.

Protection and Restoration

Conservation Goal

Secure-on-the-ground, site specific protection and/or restoration for Plant Communities of Greatest Conservation Need for parcels on public and private lands.

Conservation Objective

1) Seek out and collaborate with the Montana Forest Action Advisory Council and Montana's State Wildlife Action Plan team, and other ecologists to assist in current and new conservation efforts involving Plant Communities of GCN. Using existing decision-making support tools, as appropriate, to help determine where site-specific protection or restoration actions could occur will consolidate resources, strengthen common goals, create efficiencies, and hasten the progress to conserving Plant Species of GCN.

Outreach and Education

Conservation Goal

Facilitate the stewardship of Montana Plant Communities of Greatest Conservation Need through outreach, education, and coordination.

Conservation Objectives

1) Establish a working group to develop the conservation profile for each Plant Community of GCN (see Table 6-1 and Information Needs, Conservation Objective 1). For plant communities of cultural significance, strive to respect and reinforce Native American's Traditional Ecological Knowledge (TEK) and Indigenous Knowledge (IK), and self determination as practitioners of biodiversity conservation and ecological protection. Indigenous conservation efforts and practices can be accomplished through collaboration across jurisdictions, consultation and consent in land and water planning, research, management and pro-actively exercise mechanisms of Tribal sovereignty. Efforts will result in the removal of barriers to Indigenous people's rights to implementing land management practices (Status of Tribes and Climate Change Report (STCC) Working Group 2021).

2) Montana Field Guide[4]:
   a. The MTNHP is aiming to create a profile of each Group on the Montana Field Guide that includes photographs, global and subnational conservation status ranks, and narratives for a general description, diagnostic characteristics, distribution, component vegetation species, dynamic ecological processes, management and restoration considerations, and similar Group types. See also Information Needs, Conservation Objective #2.
   b. Revise profiles on the Montana Field Guide1 for each Plant Species of GCN and other native plant species that associate with a Plant Community of GCN. Using the newest MTNHP standards will update and expand known information on the plant species' life history, ecology, wildlife-plant interactions, identification, taxonomy, range, habitat, biology, economics, management, threats, taxonomy, and other interesting facts; improve

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[4] MTNHP Montana Field Guide: https://fieldguide.mt.gov/

Outreach and Education

readability; and link to other online resources. Cross-walking plants, animals, and habitats on the Montana Field Guide will elevate awareness of Montana's Plant Communities of GCN.

c. Revise profiles on the Montana Field Guide[1] for each animal Species of Concern that occurs within a Unique Habitat of GCN. Cross-walking plants, animals, and habitats on the Montana Field Guide will elevate awareness of Montana's Plant Communities of GCN.

4) Work with land trusts to inform them about Plant Communities of GCN and engage in discussions about conservation of Montana's Plant Communities of GCN.
5) Consult with educators or educational staff at Montana Fish, Wildlife and Parks, Helena-Lewis and Clark National Forest, Montana Native Plant Society, Tribes, and other appropriate organizations to develop educational presentations on or including Plant Communities of GCN.

Policy and Regulation

Conservation Goal

Improve conservation of Montana's Plant Communities of Greatest Conservation Need through new and existing policies and regulations in cooperation with public land managers, private landowners, and other interested stakeholders.

Conservation Objectives

1) Support state and federal agencies to collaborate and build the Montana Natural Area System by identifying and nominating existing and potential natural area sites to the board of land commissioners [MCA 79-12-104(1)] for possible designation, in accordance with the Montana Natural Areas Act of 1974 (MCA 76-12). A natural area system contains an integrated group of areas which in their entirety project representative examples of all of the state's natural systems and guarantees the continued existence of the full array of the state's biotic diversity (Roush in Loope and Bird 1986). A natural area system coordinates the management of individual areas toward common goals which are a benefit to society for recreation, education, research, aesthetic enjoyment, and the unpredictable utility of individual species (Roush *in* Loope and Bird 1986).

Photo Credit: Karen Newlon

Photo 6-2. Ecologists conducting research in a prairie pothole in north-central Montana.

Policy and Regulation

2) Nominate natural area sites that contain Plant Communities of GCN in Montana.
3) For forested Plant Communities of GCN, consult the Montana Forest Action Plan (2020) for the Statewide Assessment of Forest Conditions, Priority Areas of Focused Attention, and recommended Goals and Implementation Strategies. This document can help develop collaboration (partnerships) relative to Plant Communities of GCN.

REFERENCES

Hansen, P.; R. Pfister; K. Boggs; B. Cook; J. Joy; and D. Hinckley. 1995. Classification and management of Montana's riparian and wetland sites. Montana Forest and Conservation Experiment Station, School of Forestry, University of Montana, Miscellaneous Publication No. 54, 646 pp. plus posters.

Loop, D.; and J. Bird (eds.). 1986. Montana natural areas conference proceedings. October 14-16. The Nature Conservancy, Big Sky Field Office. Helena, Montana. 159 p.

Marks-Marino et al. 2021. Conclusions, Key Messages, Recommendations. In: The Status of Tribes and Climate Change Report (STCCWG) [Marks-Marino, D. (ed.)]. Institute for Tribal Environmental Professionals, pp. 296-303.

Montana Native Plant Strategy Steering Committee. 2019. Meeting notes for the Montana Rare Plant Conservation Strategy Kick-off Meeting. April 26th. Available from Andrea Pipp, Montana Natural Heritage Program, Helena, MT.

Montana Native Plant Strategy 'Criteria, Species, and Habitat Subcommittee'. 2021. Meetings, document review, and electronic mail correspondences. February 3 to March 31. Available from Andrea Pipp, Botanist, Montana Natural Heritage Program, Helena, MT.

Mueggler, W; and W. Stewart. 1080. Grassland and shrubland habitat types of western Montana. USDA Forest Service Gen. Tech. Rep. INT-66, Intermountain Forest and Range Experimental Station, Ogden, UT, 154 pp.

Pfister, R. D., B. L. Kovalchik, S. F. Arno, and R. C. Presby. 1977. Forest habitat types of Montana. USDA Forest Service. General Technical Report INT-34. Intermountain Forest and Range Experiment Station, Ogden, UT. 174 pp.

Roush, J. 1986. A Natural Area System for Montana: Making the Vision a Reality. In: Montana Natural Areas, Conference Proceedings, October 14-16, Billings, Montana. [Loope and Bird (eds.], The Nature Conservancy, Helena, Montana.

Status of Tribes and Climate Change Working Group (STACCWG). 2021. Status of Tribes and Climate Change Report, Institute of Tribal Environmental Porfessionals, Northern Arizona University, Flagstaff, AZ [Marks-Marino, D. editor] https://www7.nau.edu/itep/main/docs/publications/ITEP.STACC.Report_2021.pdf

SECTION 7

The Roles of Herbaria in Plant Conservation

SECTION 7
THE ROLES OF HERBARIA IN PLANT CONSERVATION

STRATEGIC GOAL: To ensure that Montana's herbaria continue to provide information and services essential to the conservation of the State's native plant species and communities, in the near- and long-term.

THE HERBARIUM

An herbarium preserves dried, pressed plant specimens that document our Nation's flora. Our Nation's many herbaria are rich in botanical biodiversity and aid the work of researchers, educators, land managers, conservation practitioners, consultants, and students. The preserved physical specimens and their associated labels with detailed information provide a foundation for classifying and communicating the names of plants, fungi, and algae found in natural settings; and those that are cultivated for agriculture, horticulture, and forestry. Additionally, herbarium specimens help us determine a species distribution; evaluate environmental variables and threats that affect plant populations; and assess the risk of extirpation or extinction for a given species. With more than 200 years of collecting, herbarium staff have embraced new technologies, making digital specimen data available to a broader audience of users for many applications. Despite the myriad of services and information provided by herbaria, the prestige and funding allocated to them, and those who manage and curate collections has declined in recent decades. Here, in the *Montana Native Plant Conservation Strategy: Species and Habitats of Greatest Conservation Need*, we present a strategy for how to support herbaria, curators, and irreplaceable plant specimens. Our goal is to ensure that Montana's herbaria continue to provide information and services that are essential to the conservation of Montana's native plant species and communities, now and into the future.

MONT
BOZEMAN MT. USA
84984

Photo Credit: Montana State University Herbarium

Photo 7-1. Bitterroot (Lewisia rediviva). *An example of an imaged herbarium specimen from the Montana State University herbarium.*

The Establishment of Montana's Herbaria

Commissioned by President Thomas Jefferson, the Lewis and Clark Expedition made notable contributions to botany from 1803 to 1806 (Phillips 2003). In preparation for the exploration, Meriwether Lewis was sent to Philadelphia to learn how to describe and preserve plant specimens. Meriwether Lewis and William Clark were directed to notice "the face of the country, its' growth and vegetable productions; especially those not of the United States, the dates at which particular plants put forth or lose their flowers, or leaf (Cutright 1969)". And so, they collected. We know that

> *Botany I rank with the most valuable sciences, whether we consider its subjects as furnishing the principal subsistence of life to man and beast, delicious varieties for our tables, shade and perfume of our groves, materials for our buildings, or medicaments for our bodies.*
>
> ~ President Thomas Jefferson [Phillips 2003]

some specimens were lost, but today 239 plant specimens, deposited at three herbaria (Phillips 2003), can be physically studied. A significant number of these plant specimens were collected in what is now present-day Montana. None of their botanical collections were "new" discoveries because Native American tribes had long established traditions for naming, describing, collecting, and using plants. The Lewis and Clark collection is Montana's oldest set of pressed and dried plant specimens, and it is accompanied by cultural, environmental, and historical information. With proper curatorial management, these labeled specimens preserve time and allow for future generations to use them to support new studies and investigations.

Following Montana's statehood in 1889, a university system was established that included biology departments and museums housing flora and fauna. These museums eventually became the present-day herbaria at the University of Montana, Montana State University, and Montana State University-Billings. Early in the formation of the National Park Service, herbaria were established at Glacier and Yellowstone National Parks. The parks herbaria allowed staff to catalog the local flora and share their knowledge with other employees and visitors. These early teaching collections quickly formed the foundation for permanent plant archives. Today, with more than 200 years of botanical exploration, collecting, and archiving, Montana's herbaria contain an impressive array and number of vascular plant, moss, liverwort, fungal, lichen, algae, and diatom specimens. These collections continue to grow in breadth and depth, and provide a foundation that documents state, regional, and national floras, field guides, and apps (Box 5-1).

Box 7-1. Books, field guides, and apps developed using specimens from Montana's herbaria.

Influential Floras

- 1950: Flora of Montana, Conifers, Monocots, & Dicotyledons — Booth
- 1973: Flora of the Pacific Northwest — Hitchcock & Cronquist
- 1974: Moss Flora of the Pacific Northwest — Lawton
- 1977, 1986: Flora and Atlas of the Great Plains—Great Plains Plant Association
- 1984: Vascular Plants of Montana — Dorn
- 1993, on-going: Flora of North America (a 30-volume flora)
- 2002: A Key to the Hepaticae of Montana — Hong
- 2012, 2022: Manual of Montana Vascular Plants — Lesica
- 2014: Montana Lichens: An Annotated List — McCune et al.
- 2017: Microlichens of the Pacific Northwest, Volumes 1 & 2 — McCune
- 2018: Flora of the Pacific Northwest, 2nd Edition — Giblin et al.
- 2021, 2023: Diatoms of Montana, Volumes 1 & 2 — Bahls

A Selection of Popular Plant Field Guides

- 1998: Plants of the Rocky Mountains - Kershaw et al.
- 2001, 2012: Central & Northern Rocky Mountain Wildflowers - Phillips
- 2005: Wildflowers of Glacier National Park - Kimball & Lesica
- 2005 Wildflowers of Montana - Schiemann

Plant Apps

- High Country Apps[1]
- Glacier Wildflowers
- Montana Grasses
- Yellowstone Region

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[1] High Country Apps: https://www.highcountryapps.com

Montana's Herbaria

This *Strategy* addresses Montana's eight, active herbaria registered with the Index Herbariorum[2] (Figure 7-1). Associated with the Montana University System (MUS) are three long-standing herbaria: University of Montana [MONTU] in Missoula, Montana State University [MONT] in Bozeman, and Montana State University-Billings [MSUB] in Billings. In 2010, the MONTU herbarium acquired the Missoula Research Center [MRC] herbarium collections from the U.S. Department of Agriculture (USDA) Forest Service's Rocky Mountain Research Station (Lesica and Stickney 2010). Associated with our state's most prominent national parks are two long-standing herbaria: Glacier National Park [GLAC] in West Glacier, and Yellowstone National Park [YELLO] in Gardiner. In addition, two national forests have registered active herbaria: Bitterroot National Forest [BNFH] in Hamilton and the Beaverhead-Deerlodge National Forest [BDNF] in Dillon. Housed at the University of Providence in Great Falls, but under private ownership and operation by the Hong family, is the Tu-Hi Hong and Pum-Hi Hong Herbarium [GFC].

Photo Credit: Yoon-Hee Hong

Photo 7-2. Yoon-Hee Hong shows how vascular plant specimens are stored in an herbarium cabinet.

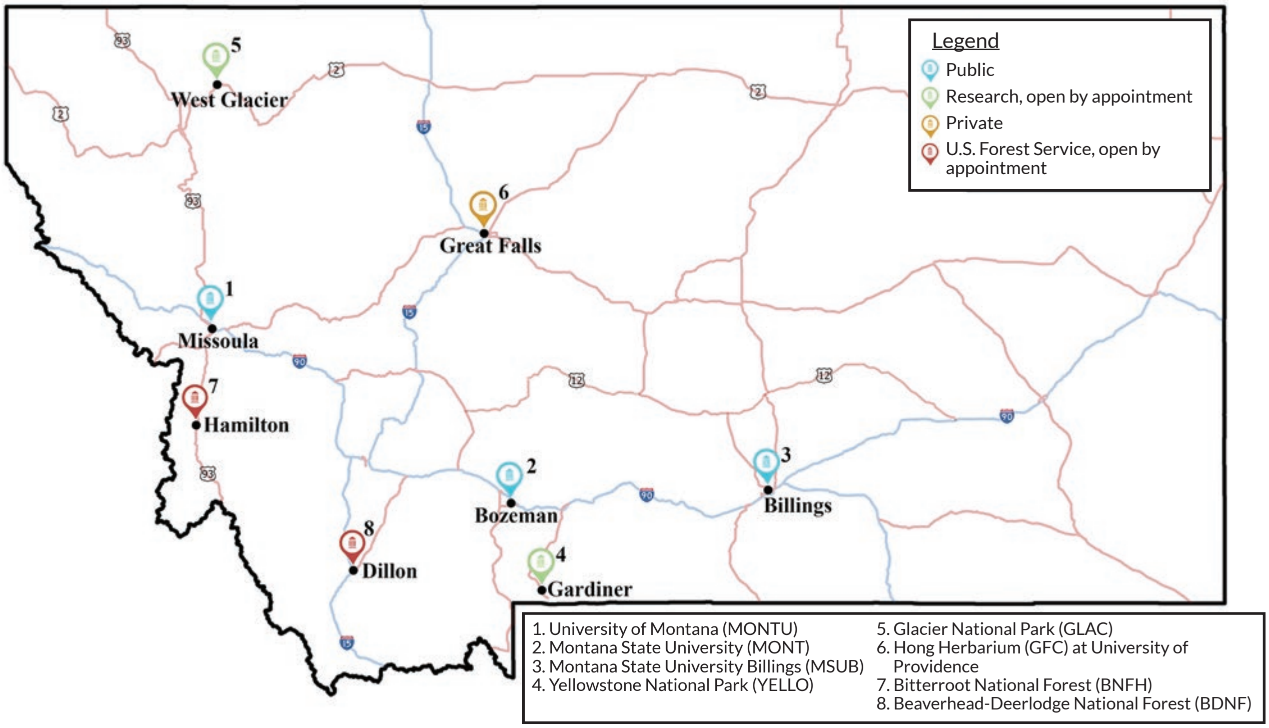
Legend
Public
Research, open by appointment
Private
U.S. Forest Service, open by appointment
West Glacier
Great Falls
Missoula
Hamilton
Bozeman
Billings
Dillon
Gardiner
1. University of Montana (MONTU)
2. Montana State University (MONT)
3. Montana State University Billings (MSUB)
4. Yellowstone National Park (YELLO)
5. Glacier National Park (GLAC)
6. Hong Herbarium (GFC) at University of Providence
7. Bitterroot National Forest (BNFH)
8. Beaverhead-Deerlodge National Forest (BDNF)

Figure 7-1. Locations of Montana's eight active, registered herbaria addressed in this Strategy.

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[2] New York Botanical Garden [NYBG] Steere Herbarium. Index Herbariorum: https://sweetgum.nybg.org/science/ih/

Disclaimer: These eight active, registered herbaria are administered by different institutions and operated separately. Each herbarium determines its mission, operational structure, and goals (Appendix D). Some herbaria have official strategies or plans in place that guide operations and functions. In addition, each herbarium controls the acquisition, curation, and databasing of their specimens. It is at the discretion of the curator or collections manager to determine what specimens are acceptable for archival[3] and teaching[4] collections. The *Montana Native Plant Conservation Strategy: Species and Habitats of Greatest Conservation Need* in no way supersedes the operations or strategic directions for any single herbarium in Montana. Rather the intent of this *Strategy* is to bring awareness to the important work accomplished by these herbaria, and to provide voluntary, non-regulatory actions that could keep operations and staff funded, continue the acquisition of collections, retain the physical specimens in Montana, and improve the digital data available to the public.

HOW HERBARIA ADVANCE PLANT CONSERVATION

Established over 120 years ago, Montana's herbaria (with an increasing number of archived specimens) advance efforts to study and manage native and exotic plants, fungi, and algae in five major ways:

1) *Herbaria Help Identify "What" to Conserve*

The invention of the herbarium made it possible for scientists to systematically name and describe plants, fungi, and algae in faraway places (Thiers 2020). Plant conservation begins with an understanding of "what" needs to be saved, preserved, eradicated, or controlled (Thiers 2020). The "what" is the name that identifies and describes the species (or variety, subspecies, genetic unit, hybrid, etc.). Scientists in the fields of plant taxonomy, systematics, and evolutionary biology rely on the indispensable, archived collections of botanical specimens to answer the question of "what". The core function of an herbarium is to obtain and manage specimen data that relays information that land managers need to determine:

- What to manage? (the species, or variety, subspecies, genetic unit, etc.)
- Where does the species live? (habitat)
- How widespread is the species? (distribution or range within defined areas)

2) *Herbaria Help Determine the Status and Conservation Merit of the Species*

The extent of Montana's herbarium specimen collections—dating back to 1804—strengthens their utility in addressing management and conservation actions. Physical specimens and their labels of information help determine origin (native, exotic, or hybrid) and uniqueness (rare versus common) at the local, regional, and national level. Specimen data are increasingly used to track distribution; and changes in population size, habitat condition, and other attributes for a given species, variety, hybrid, or another taxon (Rocchetti et al. 2021). Collectively, this information assesses the risk of a species being extirpated from an area, or the degree of invasiveness for the species (or another taxon). For example, botanists working for the newly created Montana Natural Heritage Program (MTNHP) in 1985 developed the initial Montana Species of Concern (SOC) plant list after making intensive visits to several herbaria. Revisions to the Montana SOC plant list continue to be made based on specimen data. However, maintaining an accurate SOC list requires active specimen acquisition programs and data management, to validate the need to elevate, downgrade, or remove a plant's rarity status.

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[3] Mounted dried, pressed plant specimens that have a label with information used to document a species at a particular location.

[4] Dried, pressed plant specimens that are not mounted on herbarium paper and are used in coursework to teach plant identification.

Further, the long history of plant collecting helps researchers and land managers distinguish between patterns of rarity caused by biological factors (life history traits or unique habitats) from those due to human activities. This distinction is critical for some status assessments (i.e., ranking of rarity), including the Endangered Species Act (ESA) of 1973, and for placement on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (IUCN 2023).

3) *Herbaria are Genetic Libraries*

Herbaria are genetic libraries. The DNA for each specimen can generate insights into evolutionary relationships and taxonomy (Thiers 2020; Fertig 2016). Technological advances are resolving the challenges of extracting DNA without damaging plant specimens, and genetic sequencing techniques are becoming more standard and affordable. Researchers can gain access to a single species or a diverse set of taxa, across a spectrum of time and place, by visiting or requesting loans from one or more herbaria. As examples, in 2020 MONTU loaned *Sphagnum cuspidatum* moss specimens to the State University of New York at Oneonta, and *Stellaria americana* plant specimens to the Sungkyunkwan University in Korea for genetic sequencing (Dumont 2021). In 2023, MONT specimens of native strawberry (*Fragaria*) species were loaned to researchers for genetic sequencing (Lavin 2023). Dr. Matt Lavin routinely used MONT herbarium specimens for genetic analysis of legume species over the course of his career at Montana State University in Bozeman (Lavin et al. 2018).

Herbarium specimens are also used to study changes in climate and other environmental conditions (Thiers 2020; Fertig 2016). Researchers are now capable of extracting carbon and nitrogen isotopes, atmospheric carbon dioxide, and various pollutants from herbarium specimens. This allows for cross-time comparisons of atmospheric and soil conditions. For example, stable, isotope analysis was successfully applied to 397 MONT specimens of Big Sagebrush (*Artemisia tridentata*), Idaho Fescue (*Festuca idahoensis*), Prairie Junegrass (*Koeleria macrantha*), and Bluebunch Wheatgrass (*Agropyron spicatum*) to evaluate ecosystem-level changes in plant productivity from 1881 to 2016, which was biased towards the production of carbon-rich and nitrogen-poor plants (Brookshire et al. 2020).

4) *Herbaria are Institutions of Botanical Learning*

Montana's herbaria facilitate learning through research and teaching; and by providing an opportunity for people to directly see real plants, fungi, and algae, thus empowering them. Permanent, archived specimens are used for scientific research by plant taxonomists, geneticists, ecologists, anthropologists, and specialists from other disciplines. They allow people to scrutinize specimens, agree or disagree on identifications, and annotate specimens, furthering the process of understanding. Consultants, land managers, students, and others visit herbaria to directly view and study identifiable traits, especially for a plant that is rare, or one that is a new invader to the state. Montana's public herbaria (MONTU, MONT, and

Photo Credit: Andrea Pipp

Photo 7-3. Retired USFS Research Botanist, MRC Curator, and founder of the University of Montana Herbarium endowment, Peter Stickney, shows a student an array of his herbarium specimens. Peter advocated for creative ways in which to use specimens, such as attaching photos to relay color or displaying stages of plant growth.

MSUB) also house teaching collections used in academic coursework and for specific student-guided research projects. At MONTU and MONT, “Herbarium Night” brings in students and Montana Native Plant Society (MNPS) members to engage in learning about a particular group of plants or fungi. By enabling direct experiences with specimens, herbaria help people remove “plant blindness”, the tendency to see plant species blending together without recognizing their distinctive characteristics [Balding and Williams 2016].

5) *Herbaria Provide Free Access to Digital Data*

Herbaria are taking the lead in innovative processes that provide access to millions of digitized specimens and their metadata (Rocchetti 2020). Herbarium staff are using high-resolution cameras to photograph specimens; high quality digitizing tools to scan annotations and label information; and mapping software to geo-reference collection locations. This information is integrated into databases, and it is widely accessible to everyone via online portals. Herbaria curators and collection managers collaborate to host and share specimen data, improving the utility, value, and relevance of plant specimens. The result is that plant specimen data is being used in new ways by a greater array of disciplines including genomics, resource conservation, anthropology, ecology, botany, phenology, and taxonomy (Rocchetti 2020). For example, high quality images are being used by botanical illustrators (Angell 2017). At MONTU, MONT, and MSUB, adding specimen information to digital databases is on-going with future expansion needed (Table 5-1).

Table 7-1. Online portals and data aggregators used by Montana’s herbaria as of December 2023.

Online Portal	MONTU	MONT	MSUB
Consortium of Bryophyte Herbaria [CBH]	🟩	🟩	
Consortium of Lichen Herbaria [CLH]	🟩	🟩	
Consortium of Northern Great Plains Herbaria [CNGPH]			🟩
Consortium of Pacific Northwest Herbaria [CPNWH]	🟩	🟩	
Global Biodiversity Information Facility [GBIF]	🟩	🟩	🟩

THE FUNDAMENTAL DIFFERENCE BETWEEN PHYSICAL SPECIMENS AND DIGITAL PLANT DATABASES

Photo Credit: Andrea Pipp

*Photo 7-4. A student's herbarium specimen of Serviceberry (*Amelanchier alnifolia*) displays dried cultural foods, berries, and vegetative materials. Note: Professional curators use folded paper and not plastic envelopes.*

In the digital Computer Age, collecting, sharing, and aggregating botanical information around the world by botanists, conservation practitioners, land managers, academics, citizen scientists, and others is an enormous effort. Three general categories of digital datasets are emerging and actively being used by people in Montana:

- Collaborative networks compiling digitized herbarium specimen-based field data— Examples: CBH, CLH, CPNWH, CNGPH, and SEINet[5]
- Citizen science programs compiling photo-based field data— Examples: iNaturalist, Adventure Scientists, Rare Care, and Montana Citizen Botany Program[6]
- Conservation organizations and academic institutions aggregating digital biodiversity data from numerous sources—Examples: GBIF, iDigBio, GPI, and JACQ[7]

Although publicly available, these growing datasets of digital botanical data are derived for different purposes, and differ both in the quantity and quality of information provided; and the ability to substantiate it. Nonetheless, with increased access to digital herbarium data, the fast-paced accumulation of citizen science derived data, and the aggregation of biodiversity data from numerous sources, there is a notion that it may no longer be necessary to keep or maintain specimens in a physical repository. Collections should never be discarded after they are digitized. **Physical specimens cannot be replaced by digital information.** Here, we demonstrate four reasons why it is important to obtain new physical specimens, and why existing collections should be maintained.

1) *Preserved, Physical Specimens are More Data-Rich than their Digital Counterparts*

Herbaria house a tremendous amount of biological, chemical, ecological, demographic, cultural, and historical information. The specimen itself displays morphological and reproductive features, relays phenology, and contains chemical and genetic data. Specimen labels provide additional information on geography, ecology, history, species' identification annotations, and many other details. In contrast, digital datasets from citizen science programs typically provide one to few photos, primarily relay presence data, and report little to no information on population size, habitat, and other attributes of the sighting. Even electronic scans of herbarium specimens reduce the organism from a three-dimensional to a one-dimensional image, thereby losing information.

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[5] Refer to the "Acronyms and Abbreviations" section at the end of the *Strategy*.

[6] Refer to the "Resources" section at the end of the *Strategy*.

[7] Refer to the "Acronyms and Abbreviations" section at the end of the *Strategy*.

2) Preserved, Physical Specimens Promote Education and Research

Preserved, physical specimens are necessary to support on-going education and research. Through loans and visitations, physical specimens provide a long-lasting source for teaching plant identification skills, examining traits, and conducting research for a multitude of applications, only partially addressed in this *Strategy*. This is because herbarium specimens are cataloged and kept in a stable, long-term place of storage where people can find it. While digital specimen data is available to a broader audience, it is the properly preserved specimen that gives credibility to the data and any resulting research. In addition, many significant morphological traits, such as hair type and glands, can only be directly examined or measured on the specimen with the aid of a hand-lens or microscope and ruler; small-sized morphological traits are not visible on a scanned image. Likewise, the utility of DNA and isotope extraction can't be done on a digital image.

3) Preserved, Physical Specimens are the Ultimate Data to Prove Observations

Physical specimens are irreplaceable due to their ability to validate or prove field observations and to show the range of variation exhibited by a taxon (example: species, variety, hybrid, and others). The physical specimen allows people to examine and re-examine the morphology of one individual, and to question or agree on its identity. By annotating specimens, plant taxonomists can trace the trail of examinations and identifications, which are used to update Montana's flora, field guides, and apps (see Box 5-1). Digital datasets derived from citizen science data, literature, and photographs cannot fully prove an observation.

4) Preserved, Physical Specimens Provide a Basis for Defining and Naming Organisms

Preserved, physical specimens create the foundation for defining and naming the taxon (family, species, variety, hybrid, genetic unit, and others); together, name and specimen, become the language used to communicate across disciplines, agencies, states, and countries. Specimens make it possible for scientists to examine, compare, classify, and name plants with a standard approach. These data-rich libraries of preserved collections are also a source for discovering new species. It is estimated that nearly one-quarter of newly described species resulted from existing unidentified or misidentified herbarium specimens (Bebber et al. 2010), and that as many as 70,000 undescribed plant species might still be lurking inside the world's herbaria (Bebber et al. 2010). New species are based on a single specimen, which is designated as the name-bearing "type" and archived in an herbarium; they are considered formally accepted when described in a scientifically recognized publication. Hence, type specimens are of great significance to biologists and plant taxonomy studies.

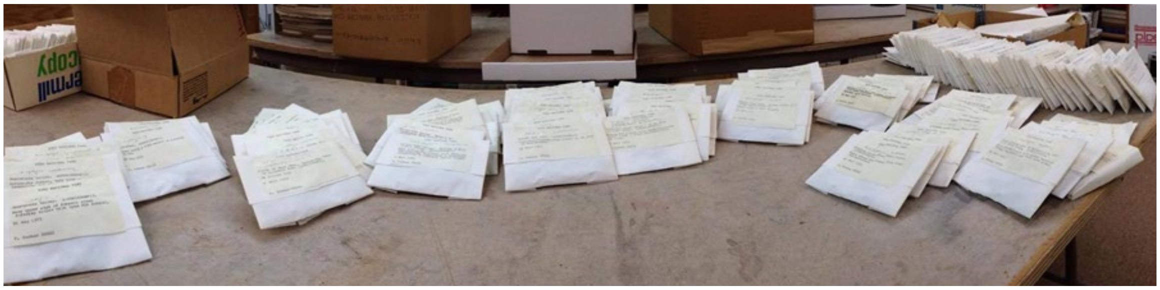

Photo Credit: Yoon-Hee Hong

Photo 7-5. Mosses, liverworts, and lichens are dried and preserved in folded paper packets with attached labels of information. Tu-Hi Hong and Pum-Hi Hong Herbarium at Great Falls.

CHALLENGES FACING MONTANA'S HERBARIA

During the past 30 plus years, the prestige and funding afforded to herbaria has waned, despite their proven utility and relevance to plant conservation and many other disciplines. The challenges faced by Montana's herbaria are similar to those faced by other herbaria across our Nation. They are complex, reflecting changes in our society, and have led to fewer collections, reductions in staff, changes in space allocations, and ultimately in less funding for herbaria (Thiers 2020). Here, we summarize seven challenges facing Montana's herbaria.

1) Shifting academic priorities

Competition for space and budget reductions have led to the closure of many university herbaria (Deng 2015). Since 1997, one herbarium in seven has closed in North America (Deng 2015; Fertig 2016). Fortunately, for most closures, the collections were transferred to other herbaria (Fertig 2016). In Montana, the MRC herbarium with more than 10,000 plant specimens was transferred from the U.S. Forest Service to MONTU in 2010 (Lesica and Stickney 2010).

2) Trends in botanical research are relying less on field observations

Biological research has shifted to studies of cellular and sub-cellular processes (Thiers 2020), such as genomics, and to landscape-level analyses like species modelling and remote sensing. These fields of study de-emphasize exploratory field studies, which were the prominent means for documenting the diversity of botanical life from the late 1800s to early 1900s (Thiers 2020), and for discovering rarity, from the 1980s to early 2000s (Pipp 2023).

3) Sifting trends in faculty positions can create potential disconnects between academic disciplines and herbaria use

The number of faculty hires specializing in specific taxa has declined as academic degrees shift to microscopic and landscape-level programs (Thiers 2020). Gradually use of the herbarium by faculty and students wanes if not supported by other academic needs. Over the past 20 years, both MONT and MONTU curators have noticed that fewer university faculty and students visit and use their academic herbarium (Bishop 2023; Lavin 2023). Likewise, the number of students authoring research papers that involve herbarium specimens has lessened (Bishop 2023). However, this apparent decline might be more accurately portrayed as a shift away from direct visitation towards accessing collections online (while also not crediting the herbarium).

4) Fewer formal botany degrees are offered in the USA

In 1988, approximately 36 of the 50 top-funded USA universities offered advanced degrees in botany (Deng 2015). By 2015, at least half of these universities no longer offered those degrees (Deng 2015). With shifting academic priorities in the Montana University System (MUS), traditional botany degrees have been retired or re-tooled into various flavors of biology, environmental studies, and forestry programs. While the *Montana Native Plant Conservation Strategy: Species and Habitats of Greatest Conservation Need* makes no inference or judgement on the degrees offered by the MUS, this *Strategy* does acknowledge the fact that fewer courses in plant identification, plant ecology, and collections management are offered to students. The consequence is that fewer graduates enter the job market with plant identification, monitoring skills, and an understanding of plant biology and ecology. Meanwhile, botanical skills continue to be highly sought after, while individuals from other professions are increasingly expected to take on botanical work.

5) *Lack of credit given to the herbaria that digitize plant data*

Online users often credit the portal or collaborative network that displays the digital data, and not the actual herbarium who funds, manages, and digitizes the specimens. A lack of advocacy by herbarium curators and collections managers has also contributed to this absence of credit (Rocchetti et al. 2021; Fertig 2016; Pipp 2023; Giblin 2021).

6) *Changes in the operation of land management organizations has reduced direct visitation and information exchanges with herbaria*

During most of the 20th Century, federal and state resource professionals frequently contributed to and/or examined plant specimens in the course of their normal work duties. This exchange of information created strong working relationships and shared work projects between curators, managers, and users. Over the past 30 years, there has been a noticeable decline in the number of visits and specimen acquisitions by federal and state resource professionals to Montana's public university herbaria (Comer 2021; Lavin 2023; Pipp 2023).

7) *A perception that herbaria are outdated*

There is a perception that herbaria are dead places, providing antiquated ways of understanding plant systematics and distributions (Deng 2015; Thiers 2020). This perception is often unfounded and one that this Strategy aims to correct.

ACTIONS

ACTIONS TO ENSURE THE LONGEVITY OF MONTANA'S HERBARIA

Although Montana's herbaria are used, the time is now to address these challenges and implement actions to ensure their longevity. This *Strategy* identifies five objectives and many subsequent actions designed to address current challenges confronting Montana's herbaria. These voluntary actions can be pursued or implemented by a single entity, or as a collaborative effort on the part of individuals, agencies, and organizations. They are presented in no prioritized order.

Objective 1.

Ensure the continued operation of Montana's herbaria through financial, institutional, and community support for staffing, equipment, space, and operational needs.

1) Communicate to decision-makers and university stakeholders the rationale for supporting each university herbarium with a collections manager, curator, and student internships.
2) Convene meetings with stakeholders (decision-makers, herbarium staff and users) to identify short- and long term funding sources and develop a financial strategy.

ACTIONS

3) Communicate to decision-makers and university stakeholders, the need for and value of returning botany classes to the curriculum for existing natural resource and biological degree programs. In these discussions, include the federal requirements for qualifying in the professional botany job series.

4) Develop community support groups and volunteers to advocate for funding and operational needs:

    a. Initiate the formation of a support group, with engagement from the respective curator. The University of Montana Friends of the Herbarium (FOH)[8] serves as a potential model. Consider expanding the FOH group to cover the three university herbaria in Montana (MONTU, MONT and MSUB), or develop focus groups specific to each herbarium. Promote student and public membership in the FOH group.

    b. Encourage financial donations to herbaria to support operations and special projects. Some herbaria have endowments, and contributions may be tax-deductible.

    c. Encourage volunteer assistance at a local herbarium. Most herbaria welcome volunteers and may rely on them for conducting day-to-day work (Thiers 2020). Academic herbaria may also offer work-study jobs and internship opportunities for students.

5) Identify potential stakeholders relative to Montana's university [U], federal [F], and/or private [P] herbaria. Potential herbarium stakeholders may include, but are not limited to:

    a. Dean of the university department that houses the herbarium. [U]

    b. Herbarium curator and collections manager. [U, F, P]

    c. Academic faculty, especially those that use the herbarium for teaching or research. [U, F, P]

    d. Students, especially those that use the herbarium for research and coursework. [U, F]

    e. Federal administrators within the National Park System. [F]

    f. Support groups associated with a specific herbarium. [U, F, P]

    g. Land management agencies (federal, state, county) and extension services, who may have established workflow processes or formal agreements that specify the repository to use for collections and validating specimen identification. [U, F, P]

    h. MTNHP botanist and program lead whose work relies heavily on herbaria. [U, F, P]

    i. Collaborators at online herbarium portals. [U, F, P]

    j. Other users of the herbarium. [U, F, P]

6) Develop an operating strategy for MONT and MSUB herbaria that involves leadership from the curator, collections manager, and appropriate University Dean.

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[8] See "References" for FOH newsletters, and the "Resources" section at the end of the *Strategy*.

ACTIONS

Objective 2.

Implement efforts to strengthen or create working relationships between the herbarium, federal and state land management agencies, non-governmental organizations (NGOs), consultants, and private landowners.

1) Identify users specific to the herbarium, with the goal to strengthen (or create) working relationships.
2) Advertise products, in-person and on-line resources, and other services provided by the herbarium to land management agencies, NGOs, consultants, landowners, and other users.
3) Identify data gaps in herbarium specimens that pertain to taxa, time, and/or geography.
4) Develop and strengthen partnership agreements between users and herbarium staff. Partnership agreements should identify commitments made by all parties involved.

Photo Credit: University of Montana Herbarium

Photo 7-6. Herbarium Night at the University of Montana herbarium. Members of the Montana Native Plant Society build their plant identification skills using microscopes and pressed plants.

5) Organize a Montana-based herbaria working group that advocates for the preservation, function, and relevance of herbaria. A working group could also address statewide challenges, create efficiencies, and foster relationships with land management agencies and non-governmental organizations. Key members may include, but are not limited to:
    a. Curators
    b. Collection managers
    c. MTNHP botanist
    d. MNPS representatives
    e. Government and non-government herbaria users
6) Host workshops and demonstrations at the herbarium to teach land managers, consultants, and other users the best practices for collecting, pressing, drying, and recording associated data for plants, fungi, and algae. This could be done in conjunction with the MNPS, Master Naturalist program, county weed extension service, and others.

ACTIONS

7) Create how-to-videos under the name of the herbarium and market to consulting firms, land management agencies, and NGOs.
8) Identify websites and other places to showcase the partnership that developed between the herbaria and MNPS to create Montana Grasses and Glacier Wildflowers apps. Ensure that these products are prominently displayed with proper credits, and easy to find on or download from the MNPS website. These actions could bring stronger awareness and recognition to herbaria and the MNPS.
9) Use data aggregators like GBIF and iDigBio[9] to track scientific publications that cite herbaria specimen data. These data aggregators can help track use that a curator or collections manager may not be aware of. Information on how specimen data is useful to a wide audience helps demonstrate the use and value of herbaria.

Objective 3.

Build relationships between the herbarium, MNPS, and non-profit organizations.

1) Identify non-profit organizations, community support groups, and individuals that are (avid) users of the specific herbarium.
2) Collaborate with the MNPS and other non-profit groups to host educational events or fund-raising efforts. MNPS members, non-profit groups, and individuals could host workshops that focus on a specific species, family, or vegetation community.
3) Create a website or team with a partnering organization to host plant inventory checklists and/or manage personal checklists by MNPS members. This could encourage MNPS members and other botany amateurs to use herbaria to resolve their plant identification problems and create a support group for the herbarium. The Washington Native Plant Society (WNPS) serves as a potential model. WNPS teamed together with CPNWH staff to host a password-protected webpage where members can create and edit personal plant lists and geo-reference field trip locations.
4) Collaborate with the Montana Citizen Botany Program to sponsor forays designed to fill specific-herbaria data gaps and provide opportunities for winter-time plant identification and specimen preparation
5) Encourage the MNPS-MTNHP Citizen Botany Program (if available) or other botany interest groups to conduct a bio-blitz or foray (collection trip) to address an herbarium's data gaps. When coordinated with the curator or collections manager, these activities also provide plant identification and specimen curation projects for amateur and professional botanists in winter or at other times.
6) Evaluate users' experiences at the herbarium, identify potential problems, and make recommendations for change. Factors that can improve or hinder individual use include ease of access, campus parking, space accommodations for examining specimens, ability to contact staff, etc.

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[9] Refer to the "Resources" section at the end of the *Strategy*.

ACTIONS

Objective 4.
Promote herbaria and plant education through outreach actions.

1) When using information sourced by an online portal or herbarium, credit the herbarium that directly manages and digitizes the specimen(s) and data.

2) Create educational displays that showcase herbaria collections, plant preservation techniques, botanical collectors, history of botanical exploration, and other related topics. Displays can promote learning opportunities and pique interest in herbaria.

    a. Continue to display MONTU's collections on the University of Montana campus, such as occurring in the Health Sciences and Mansfield Library buildings; seek out new opportunities for campus displays.

    b. Bring herbarium-themed educational programs and presentations to primary and secondary schools, art classrooms, and community groups, including Girls in Science, Girl Scouts of the USA, Boy Scouts of America, Future Farmers of America, and many others. Teaching children to identify plants, create plant lists, and preserve specimens builds connections with plants while building curiosity.

    c. Collaborate with art galleries, museums, and/or American Society of Botanical Artists (ASBA-Rocky Mountain Chapter) to display herbarium specimens or the art of curation. Examples include, but are not limited to:

        - Create a travelling exhibition focused on plants collected by Montana's early botanists and curated at a Montana herbarium.
        - Host an annual art contest; develop a contest in the same vein as the Federal Duck Stamp.
        - Teach botanical illustration classes using herbarium specimens or images.

3) Encourage members of the community to write articles that highlight a particular herbarium in local, regional, or state-wide newsletters. Newsletter articles that highlight specific plants or projects relative to the organization's mission promotes learning and creates awareness of a local herbarium. This could include historical information, current research, or special collections.

Photo Credit: Jane Olson

Photo 7-7. The Yellowstone National Park botanist carefully spreads out the collected plant before placing it in the plant press.

ACTIONS

Pertinent conservation organizations[10] that produce a newsletter include, but are not limited to:

a. The MNPS [*Kelseya*]
b. College and university campus newspapers
c. National Park Service publications
d. Montana Historical Society [*Montana the Magazine of Western History*]
e. Montana Audubon Society [Monthly E-News]
f. Montana Watershed Coordination Council [*Watershed News*]
g. Montana Association of Conservation Districts [*The Montana Conservationist*]
h. The Nature Conservancy [*Nature Conservancy Magazine*]
i. Penstemon Society
j. Eriogonum Society

Objective 5.

Ensure collections remain relevant and accessible through specimen data digitization and acquisition.

1) Pursue funding opportunities in concert with natural resource professionals, herbarium support groups, non-profits, and others. Consider fund-raising campaigns, memberships, and donations. Funding is needed to:
   a. Repair, purchase, and loan equipment and software used to accession, photograph, and digitize specimens at all eight herbaria.
   b. Pay staff salaries and/or student internships.
   c. Cover shipping and mailing costs for specimen loans.
   d. Purchase herbarium supplies.
   e. Keep the lights on, and facilities maintained.

2) Pursue grant opportunities to fund special projects, equipment, or events. Consider collaborating with state or regional herbaria to strengthen the need for projects or the expected outcomes of proposed work. Potential funding sources include the Institute of Museum and Library Services and the National Science Foundation.

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[10] (a) Kelseya Archive: https://mtnativeplants.org/archive/
(d) Montana the Magazine of Western History: https://mhs.mt.gov/pubs/Magazine1
(e) Montana Audubon Society Monthly E-News: https://mtaudubon.org/news
(f) Watershed News: https://www.mtwatersheds.org/resources/watershed-news/
(g) The Montana Conservationist: https://macdnet.org/category/the-montana-conservationist/
(h) The Nature Conservancy Magazine: https://www.nature.org/en-us/magazine/
(i) Penstemon Society: https://penstemons.org/index.php
(j) Eriogonum Society: https://eriogonum.info
Also see "Resources" at the end of the *Strategy*.

ACTIONS

3) Convene a working or sub-group comprised of curators and collection managers to assess statewide needs common to the eight Montana herbaria (see also Objective 2, #5). This could include developing tasks, workflow processes, and formal agreements among all parties, and address how the needs within their facility might dovetail with the needs of other herbaria (Pipp 2023).

4) Communicate with land managers, extension services, and NGOs on the value of and need for acquiring specimens. Specimen acquisition includes, but is not limited to:

   a. Taxa new to state, county, or other defined geographical area,

   b. Taxa representing current times.

   c. Taxa or specimens that fulfill the herbarium's mission.

   d. Taxa with special designations: Species of GCN; SOC; PSOC; Sensitive: Species of Conservation Concern; and others.

   e. Existing specimens from other herbaria.

5) Encourage University herbaria to share via data aggregators (IDigBio, GBIF, etc.) to expand the herbarium's users, and educate them to credit the herbarium that funds, stores, manages, and digitizes the collections.

REFERENCES

Angell, B. 2017. In praise of virtual herbaria. J. Am. Soc. Botanical Artists. 23(4): 26-27.

Balding, M.; Williams, K. 2016. Plant blindness and the implications for plant conservation. Conservation Biology. 30(6): 1192-1199. https://conbio.onlinelibrary.wiley.com/doi/10.1111/cobi.12738

Bebber, D. et al. 2010. Herbaria are a major frontier for species discovery. PNAS 107(51): 22169-221171.

Bishop, G. 2023. Personal communication. Curator, University of Montana Herbarium, Missoula, MT (25 April)

Brookshire, E.; Story, P.; Currey, B.; Finney, B. 2020. The greening of the Northern Great Plains and its biogeochemical precursors. Global Change Biology. 26(10): 5404–5413.

Comer, J. 2021. Personal communication: Interview with Jason Comer, Professor of Botany, Montana State University-Billings, conducted by Andrea Pipp. [25 June 2021].

Cutright, P. 1969. Lewis and Clark: Pioneering naturalists. Lincoln, NE: University of Nebraska Press. 506 p.

Deng, B. 2015. Plant collections get pruned back: North America's herbaria wilt under budget pressure. Nature. 523.

Dumont, J. 2021. Spring Newsletter. Missoula, MT: Friends of the University of Montana Herbarium. 8 p. https://www.umt.edu/herbarium/documents/newsletters/2021-foh-newsletter.pdf [9 December 2023]

Fertig, W. 2016. Are herbaria still relevant in the 21st century? Sego Lily. 39(1): 6-8. Available online: https://www.npsoregon.org/bulletin/2017/NPSO_1710.PDF [9 December 2023]

Hong, Won Shic. 2002. A Key to the Hepaticae of Montana. Northwest Science. 76(4): 271-285.

IUCN. 2023. The IUCN red list of threatened species. Version 2022-2. IUCN 2023. The IUCN Red List of Threatened Species. Version 2022-2. https://www.iucnredlist.org [9 December 2023]

Giblin, D. 2021. Interview with David Giblin, Consortium of Pacific Northwest Herbaria. Conducted by Andrea Pipp, Botanist, Montana Natural Heritage Program, Helena, MT. (15 November).

Gross, B.; Etterson, J.; Vallez, J. 2022. The past, present, and future of Minnesota's rare relict sites. Presentation. Natural Areas Association.

Lavin, M., R. T. Pennington, C. E. Hughes, G. P. Lewis, A. Delgado Salinas, R. Duno de Stefano, L. P. Queiroz, D. Cardoso, M. F. Wojciechowski. 2018. DNA sequence variation among conspecific accessions of the legume *Coursetia caribaea* reveal geographically localized clades here ranked as species. Systematic Botany 43 (3): 664–675. https://doi.org/10.1600/036364418X697382 [11 December 2023]

Lavin, M. 2023. MONT specimen loans of *Fragaria*. Electronic mail correspondence between Matt Lavin, Professor, Montana State University, Bozeman, MT and Elizabeth Bergstrom, Ennis, MT. (23 March 2023).

Lavin, M. 2023. Personal communication. Professor, Montana State University, Bozeman, MT.

Lesica, P.; Stickney, P. 2010. Forest Service's MRC herbarium moves across campus. In: Newsletters, Spring 2010. Missoula, MT: Friends of the University of Montana Herbarium. https://www.umt.edu/herbarium/documents/newsletters/spring-2010.pdf [9 December 2023]

New York Botanical Gardens (NYBG) Steere Herbarium. 2023. Index Herbariorum. Bronx, New York. https://sweetgum.nybg.org/science/ih/ [9 December 2023]

Phillips, W. 2003. Plants of the Lewis and Clark expedition. Missoula, MT: Mountain Press Publishing Company. 277 p.

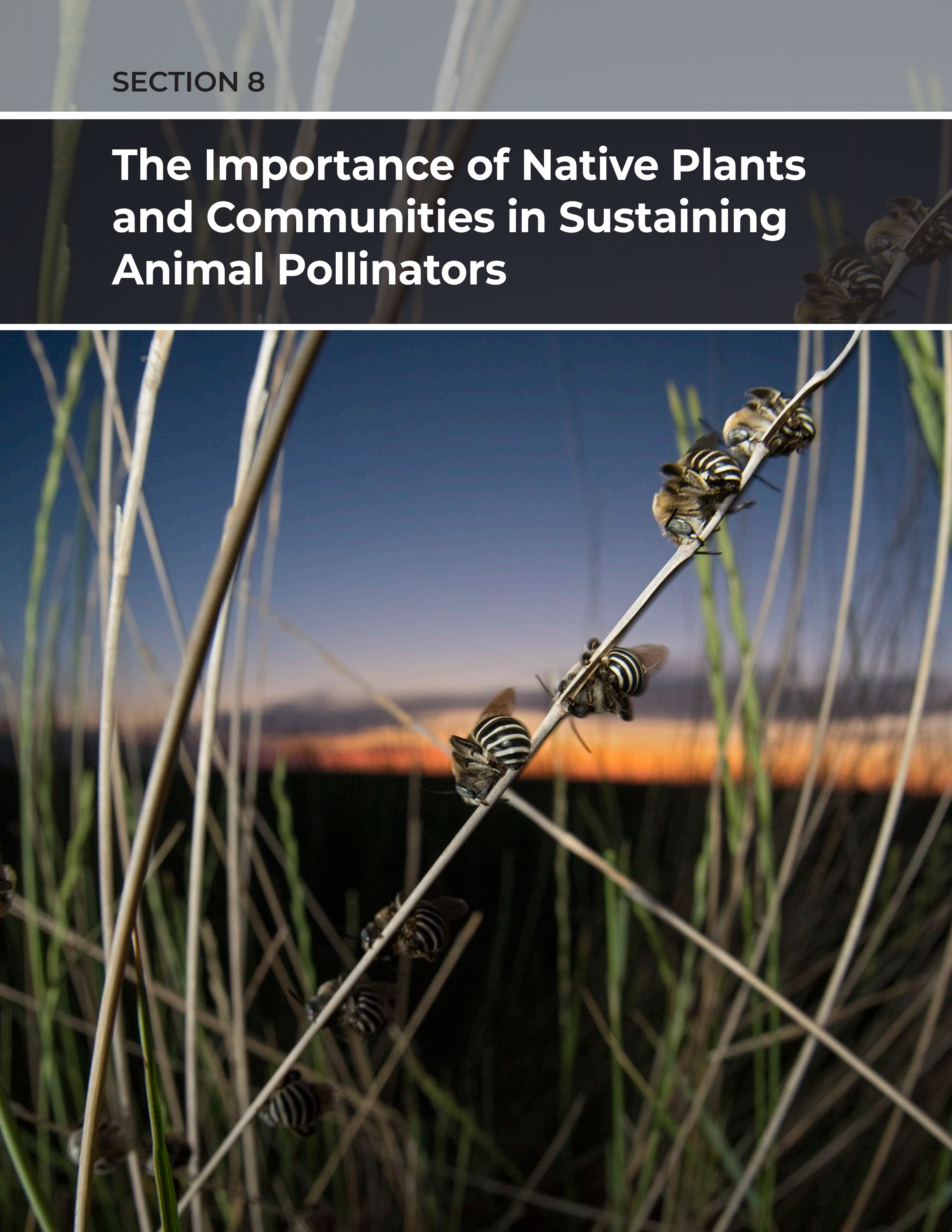
Rocchetti, G.; Armstrong, C.; Abeli, T.; Orsenigo, S.; Jasper, C.; Joly, S.; Bruneau, A.; Zytaruk, M.; Vamosi, J. 2021. Reversing extinction trends: New uses of (old) herbarium specimens to accelerate conservation action on threatened species. New Phytologist. 230: 433-340.

Pipp, A. 2023. Personal communication. Botanist, Montana Natural Heritage Program, Helena, MT.

Thiers, B. 2020. Herbarium, the quest to preserve and classify the world's plants. Portland, OR: Timber Press Inc.: 13 p.

SECTION 8

The Importance of Native Plants and Communities in Sustaining Animal Pollinators



SECTION 8

THE IMPORTANCE OF NATIVE PLANTS AND COMMUNITIES IN SUSTAINING ANIMAL POLLINATORS

STRATEGIC GOAL: To heighten awareness of how native plants sustain native pollinator populations, and the ways people can use native vegetation to promote communities and pollinators.

The Earth provides a multitude of habitats for plants, which are sustained by the interdependence between flowering plants and animal pollinators. Relationships between plants and pollinators co-evolved more than 65 million years ago (Proctor et al. 1996). Today, nearly 88% of the world's 352,000 flowering plant species are pollinated with the help of animals (Ollerton et al. 2011). This symbiotic relationship has shaped the diversity of both plants and animals in our region, and across the globe. Yet, the attention given to this relationship often focuses more on the animals that pollinate, and less on the origin, traits, and species of the plants that sustain them.

This section, *The Importance of Native Plants and Communities in Sustaining Animal Pollinators*, hereafter *Native Plants and Pollinators*, does not provide a strategy to conserve pollinators. Rather, the *Native Plants and Pollinators* section touches on the important services Montana's native plants and plant communities provide to pollinators, the need to preserve and use them in restoration, and the effect pollinators have on rare and common native plants. Further, it highlights existing resources, relevant to Montana, that private landowners and public land managers can use to promote native plants, create communities, and in turn support animal pollinators.

Mutual Reliance Among Native Plants, Plant Communities, and Animal Pollinators

The coexistence of native plants and native animal pollinators hinges on the persistence of these species to live in functioning plant habitats. Such plant habitats could be found in one's backyard garden or in the wildest of places, and everywhere in between (Tallamy 2009). Native plants differ in their size, shape, habit, soil, water and nutrient requirements, and leaf chemistry, which means that where there is a diversity of plant species, there will be greater opportunities for animals to obtain their energy (food) without interfering with one another (Tallamy 2009). A greater array of native plant species also means more opportunities for native animal pollinators to find shelter, nesting, and resting sites, whether daily or seasonally, along with water, prey, and other components to carry out their life cycles. In Montana native animal pollinators include insects, bats, and birds. Of particular importance are the insect herbivores like caterpillars, which many of Montana's more charismatic birds and mammals rely upon (Tallamy 2009).

At least 1,890 flowering plant species native to Montana provide nutritious foods in the form of pollen and/or nectar to native animal pollinators (MTNHP 2023a). While foraging for this food, pollinators transfer pollen from the stamens of one flower to the pistil of another flower, thereby enabling fertilization and seed production for the plant. Hence, the reproductive success of most native plant species depends on their animal pollinators.

For both plants and animals, the biology of pollination has led to species being generalists or specialists. Generalists pollinate many flower types or are pollinized by many animal species. Specialists have unique anatomical structures and pollinate specific flower species or are pollinized by certain animal types. Specialist pollinators and specialist pollinizers bring uniqueness to Montana's flora and fauna; specialists may or may not be rare species and may or may not rely on generalist species. Three examples, below and Box 8-1, illustrate some relationships between common and rare species for both native plants and animals:

- The corolla length, curvature, and volume of a nectar-producing flower corresponds well to a hummingbird's bill length, curvature, and body mass (Maglianesi et al. 2014). As a result, hummingbirds are attracted to odorless flowers that open during the day, are brightly colored, funnel-shaped with recurved petals, and typically have strong stems for perching.
- Spalding's Catchfly (*Silene spaldingii*), a federally-threatened plant that grows in the grasslands of northwestern Montana is primarily pollinated by the Golden Northern Bumblebee (*Bombus fervidus*) (Lesica and Heidel 1996; Hatten 2019) (Photo 8-1). The Golden Northern Bumblebee is a widespread, generalist insect that forages on numerous plant species that represent various floral types (Photo 8-1).

Native flowering plants are more than a food source, and when growing within a community of native plants, pollinators are provided with the resources needed to carry out their entire life cycle. Native plant communities provide essential water sources for pollinators by trapping precipitation and tempering moisture levels. For many birds and bats, native trees and tall shrubs provide nesting, roosting, and over-wintering habitats. For pollinating insects and birds, the native forb and grass components of these communities provide shelter, nesting, and over-wintering habitats. Native plants with hollow stems become sites for adult and larval insects to take shelter or over-winter in. As examples, Joe-Pye Weed (*Eupatorium* spp.), Elderberry (*Sambucus* spp.), Wild Bergamot (*Monarda fistulosa*), and Swamp Milkweed (*Asclepias incarnata*), are a few of the plants that produce hollow or pithy stems suitable for nesting bees (Tufts Pollinator Initiative 2023). Undisturbed soils with leaf litter and some vegetative cover provide insulation and protection for caterpillars to complete their pupal stage of metamorphosis, to become a butterfly or moth pollinator (Tallamy 2009).

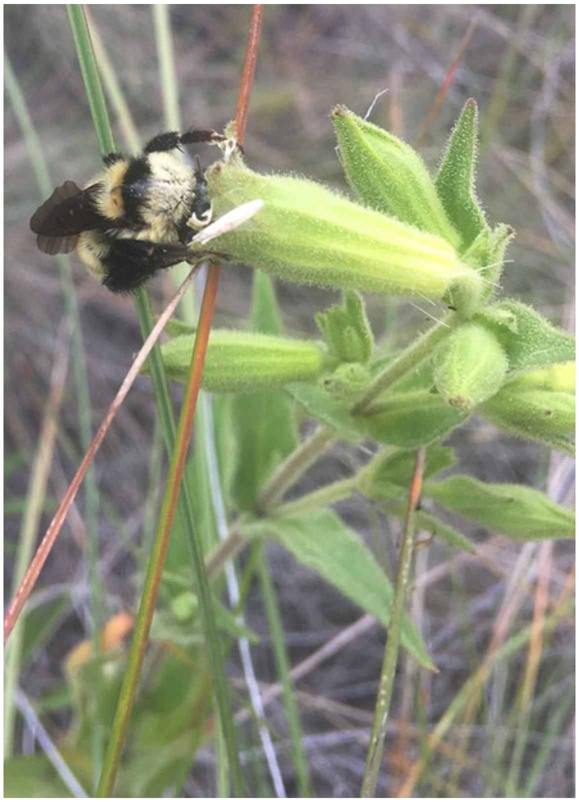


Photo Credit: Emma Heydenberk

*Photo 8-1. A Spalding's Catchfly (*Silene spaldingii*) flower gets a visit from the Golden Northern Bumblebee (*Bombus fervidus*) pollinator on the Flathead Indian Reservation.*

Native plant communities across the landscape naturally vary in the timing, density, nutritional value, and floral morphology of flowering, all of which influence native pollinator communities (Essenberg 2013, Bruckman and Campbell 2014, Palladini and Maron 2014, Scheper et al. 2015, Cariveau et al.

Box 8-1. Lemhi Beardtongue & Large Pollen Wasp – A Reciprocal Connection.

Reciprocal Relationships

Pollen wasps look similar to yellow jackets, but differ in having club-shaped antennae, vegetarian diets, and unique behaviors. All species of the pollen wasp genus, *Pseudomasaris*, specialize in rearing their young on nectar and pollen, as opposed to scavenging on meat or preying on other insects. Their eggs are laid in a ground nest composed of soil, nectar, and a pollen patty that is sealed with mud (Beyond Pesticides 2023). As specialists, pollen wasps forage on specific types of plants.

Montana's only representative is the Large Pollen Wasp (*Pseudomasaria vaspoides*), which is a pollinator of Lemhi Beardtongue (*Penstemon lemhiensis*), a rare plant found only in southwest Montana and adjacent Idaho (Stucki 2013; MTNHP 2023b). Although flowers of Lemhi Penstemon may be visited by several insect species, the Large Pollen Wasp is a particularly efficient pollinator. Behaving more like a bee, its body fits perfectly into the flower of Lemhi Beardtongue, and as it feeds on nectar, the wasp's body collects pollen. Their reciprocal connection allows Lemhi Beardtongue to produce more seeds and improve its genetic diversity while the Large Pollen Wasp gains pollen to feed its larvae (Starkey 2015).

Watch the video showcasing Lemhi Beardtongue and Large Pollen Wasp at the Big Hole National Battlefield in Montana[1]:

Species Conservation

Lemhi Beardtongue plants and Large Pollen Wasp insects are unique members of our national heritage that deserve conservation. Ranked as being vulnerable to extirpation in Montana and Idaho, Lemhi Beardtongue faces threats from altered fire regimes, exotic plant invasions, herbicide applications, and drought (IDNHP 2023; MTNHP 2023b; Sagatelova et al. 2023; Stucki 2013). Found across the western United States and Canada, the status of the Large Pollen Wasp is unknown in Montana but ranked as imperiled in Canada (NatureServe 2023). Their reliance on each other requires conservation practices that encompass both species and habitat. A 2023 publication outlining a proactive collaborative conservation strategy to maintain wild Lemhi Beardtongue populations aims to advance conservation practices (Sagatelova et al 2023).

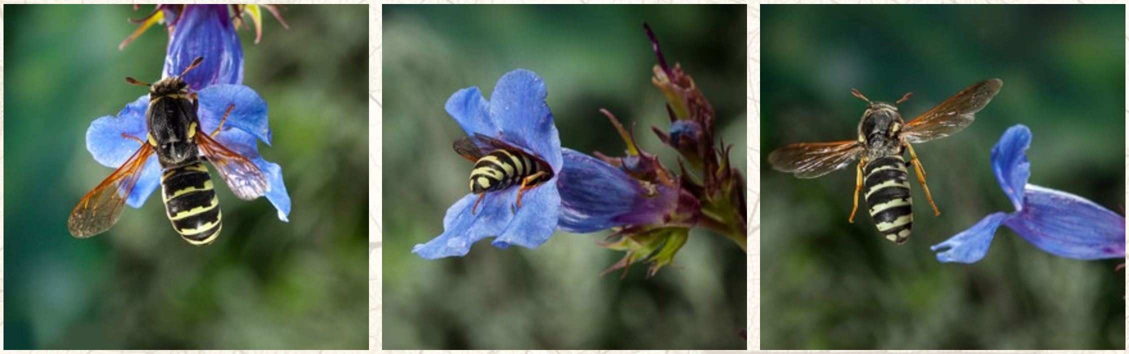


Photo credits:
©Michael Durham | DurmPhoto.com

Photos 8-2 to 8-4. The Large Pollen Wasp pollinates a flower of Lemhi Beardtongue.

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[1] National Park Service Inventory and Monitoring YouTube channel: https://www.youtube.com/watch?v=EqppGx7Wv-s

2020). Native pollinator populations are most successful when they have access to diverse types of native flowering plant species because they provide multiple resources throughout the growing season for mating, nesting, and food (Tepedino et al. 1997). When these resources become sparse or unavailable, common native plant species and plant communities also decline in size, function and/or health (Wei et al. 2021). Where conservation actions favor rare species, the ability to maintain diverse communities improves (Wei et al. 2021). This is because community-wide plant-pollinator interactions affect reproduction which is important for maintaining biodiversity (Wei et al. 2021).

Select Ways in Which Exotic Plants & Pollinators Affect Native Plants & Pollinators

Native pollinators perform an essential role in the reproduction and persistence of native plants and their plant communities; however, Montana's landscapes also include increasing numbers of exotic (or non-native) flowering plant and animal pollinator species. Although the presence of non-native plant species may increase floral resources and attract generalist pollinators, specialist pollinators that rely on specific native host plants can be outcompeted, at the loss of their preferred food (Valdovinos et al. 2016). Furthermore, invasive plants often alter the composition and structure of native plant communities, which in turn negatively impacts pollinator visitation to native plants, limiting plant reproduction and future generations of seedlings (Palladini and Maron 2014).

Similarly, non-native pollinators such as the European Honey Bee (*Apis mellifera*) impact native plant communities by preferentially foraging on and depleting the most abundant floral resources in an area (Hatfield et al. 2018). Honeybees also compete with native pollinators for floral resources (Thomson 2016, Hatfield et al. 2018) and can even exclude, suppress, and/or displace native bees from flowers (Thomson 2004, 2006; Hatfield et al. 2018). This causes native pollinators to shift to less abundant and less rewarding plant species, thereby reducing flower visitation, and pollination for many native plant species. When native pollinators are unavailable, honeybees may not provide sufficient pollination for certain native plant species, leaving those species with reduced reproduction (Hatfield et al. 2018). Thus, the persistence of pollinators must be considered in the long-term conservation of both native plant and pollinator communities (Wei et al. 2021).

Photo Credit: Aaron Clausen

Photo 8-5. Blue butterfly (family Lycaenidae*) foraging on a buckwheat* (Eriogonum sp.) *plant near Babb, Montana.*

HOW TO PROMOTE NATIVE PLANTS, COMMUNITIES, AND ANIMAL POLLINATORS

In this subsection on *Native Plants and Pollinators*, we link to existing resources, relevant in Montana, to encourage the plantings of flowering plants native to our state. In turn, successful plantings with proper planning can support both native plant populations and native pollinator communities. With a little research and effort, creating and maintaining native plant communities can be done in small places, like one's backyard.

Resources for Land Management Agencies and Other Landowners

Western Montana & Northern Idaho Region

Pollinator-friendly Seed Mixes

In Montana, U.S. Department of Agriculture, Forest Service land managers are assessing the resources that specific native plant species provide to bees and using this information to design seed mixes for restoring pollinator habitat. These land managers define "pollinator-friendly" native plants as "species that have high visitation rates by bees, attract the greatest number of bee species, support specialist bee species, and bloom for extended periods across the landscape".

We encourage readers to read General Technical Report (Glenny et al. 2022). Below, we summarize some of their important findings that apply to western Montana and northern Idaho:

- To support the local pollinator community, seed mixes used for restoration projects should have a diverse suite of native species that exhibit a range of floral morphologies, with bloom times that collectively span the entire flowering season.
- Native seed mixes, plugs, and plantings perform best when they are from locally adapted species.
- The report provides a scorecard that rates the pollinator-friendliness of 24 native plant species and provides details on each species' growth form, flowering period, and use by pollinators.
- The report provides recipes for seed mixes designed for common habitat types and disturbance regimes.
- The report lists native plants with the potential to qualify as pollinator-friendly.

Find it! https://www.fs.usda.gov/research/treesearch/63732

National Programs

National programs that incorporate pollinator-friendly and wind-pollinated native plants, and emphasize locally sourced plant materials, are being implemented in revegetation and rehabilitation projects conducted by the U.S. Department of Interior, Montana/Dakotas Bureau of Land Management and Region 1 of the Forest Service. These national programs include:

National Seed Strategy for Rehabilitation and Restoration

Find it! https://www.blm.gov/sites/default/files/docs/2020-12/NationalSeedStrategy_2015-2020.pdf

Seeds of Success – Native Seed Collection

Find it! https://www.blm.gov/programs/natural-resources/native-plant-communities/native-plant-and-seed-material-development/collection

Forest Service Native Plant Restoration Program

Find it! https://www.fs.usda.gov/wildflowers/Native_Plant_Materials/policy.shtml

Resources for Private Landowners and Conservation Organizations

The following resources provide guidance to private landowners interested in finding and selecting native plants for each region of Montana. These resources may also address planting techniques and plant-pollinator relationships.

Sources for Montana Native Plants

Montana Native Plant Source Guide - Montana Native Plant Society (MNPS) Landscaping and Revegetation Committee (with periodic updates)

- Montana's best source guide for finding native plant materials and learning how to grow select species by seed.
- The MNPS website provides additional information on growing and landscaping native plants.

Find it! https://mtnativeplants.org/wp-content/uploads/2024/04/Native-Plant-Sourceguide-April2024.pdf

Montana Conservation Seedling Nursery

The nursery is an agricultural facility located in Missoula dedicated to providing plants for conservation work across Montana. It is operated by the Montana Department of Natural Resources and Conservation as a state proprietary enterprise.

Find it! https://dnrc.mt.gov/Forestry/Conservation-Nursery

Photo Credit: Unknown

Photo 8-6. Carpenter bee (Xylocopa sp.) nest occupied by pupa, and a singular larva (far right), after the pithy material was excavated from the stem of a native woody plant.

Information on Pollinator-friendly Species and Ecoregional Planting Guides for Montana

Montana Native Plants for Pollinator-Friendly Plantings

- U.S. Department of Agriculture, Natural Resources and Conservation Service (2005)

Provides information on common shrubs and forbs native to Montana that benefit native animal pollinators.

Find It! https://www.nrcs.usda.gov/plantmaterials/mtpmcbr11694.pdf

Pollinator Partnership

A non-profit organization that promotes the health of pollinators through conservation, education, and research. The website provides ecoregional planting guides for the Great Plains Steppe, Middle Rocky Mountain, and Northern Rocky Mountain regions.

Find it! https://pollinator.org/guides

Homegrown National Park

A grassroots call-to-action movement that regenerates biodiversity and ecosystem functions. Their website lists keystone (most productive) tree, shrub, and forb species that promote biodiversity and are native to the Western Cordillera and West-Central Semi-Arid Prairies regions of Montana. The website invites you to participate as a partner in planting native plants in your backyard!

Find it!: https://homegrownnationalpark.org/about-us/

Resources for Private Landowners and Conservation Organizations

Pollinator Conservation

Xerces Society

An international non-profit organization that focuses on the conservation of invertebrates. The website provides information for planning, establishing, restoring, and maintaining pollinator habitats for the Mountain and North Central regions found in Montana.

Find it! https://www.xerces.org/pollinator-resource-center

Photo Credit: Aaron Clausen

Photo 8-7. A sweat bee (Lasioglossum sp.) *forages on Springbeauty* (Claytonia lanceolata) *flowers near Bozeman, Montana.*

Federal Initiatives

U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service is engaged with projects and efforts (initiatives) to further the conservation of pollinators.

Find it! https://www.fws.gov/initiative/pollinators

Forest Service

The Forest Service provides information on native plant conservation, restoration projects, pollinators, and wildflowers.

Find it! Conservation and restoration: https://www.fs.usda.gov/research/rmrs/centers/wcnp

Pollinators and native wildflowers: https://www.fs.usda.gov/wildflowers/pollinators/

> ***The first law of intelligent tinkering is to save all the parts.***
>
> ~ Aldo Leopold

REFERENCES

Beyond Pesticides. 2023. August's PolliNATION Pollinator of the Month-The Pollen Wasp. Daily News Blog. Available online: https://beyondpesticides.org/dailynewsblog/2017/08/augusts-pollination-pollinator-month-pollen-wasp/ [Accessed 26 December 2023]

Bruckman, D.; Campbell, D. R. 2014. Floral neighborhood influences pollinator assemblages and effective pollination in a native plant. Oecologia. 176: 465–476.

Cariveau, D. P.; Bruninga-Socolar, B.; Pardee, G. L. 2020. A review of the challenges and opportunities for restoring animal-mediated pollination of native plants. Emerging Topics in Life Sciences. 4: 99-109. Available online: doi.org/10.1042/ETLS20190073

Essenberg, C. J. 2013. Explaining the effects of floral density on flower visitor species composition. American Naturalist. 181: 344-356.

Glenny, W.; Runyon, J.; Burkle, L. 2022. Assessing pollinator friendliness of plants and designing mixes to restore habitat for bees. Gen. Tech. Rep. RMRS-GTR-429. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 52 pp. Available online: doi.org/10.2737/RMRS-GTR-429

Hatfield, R. G.; Jepsen, S.; Vaughan, M.; Black, S.; Lee-Mader, E. 2018. An overview of the potential impacts of honeybees to native bees, plant communities, and ecosystems in wild landscapes: Recommendations for land managers. The Xerces Society for Invertebrate Conservation. 12 pp.

Hatten, T. D. 2019. Baseline monitoring for pollinators of Spalding's catchfly (*Silene spaldingii*) in the channeled scablands of Eastern Washington. Unpublished report. 25 pp.

Hanula, J. L.; Ulyshen, M. D.; Horn, S. 2016. Conserving pollinators in North American forests: A review. Natural Areas Journal. 36(4): 427–439. Available online: https://www.researchgate.net/publication/309018903_Conserving_Pollinators_in_North_American_Forests_A_Review

Idaho Natural Heritage Program (IDNHP). 2023. Information on *Penstemon lemhiensis* in Idaho. Boise, Idaho. https://idfg.idaho.gov/species/taxa/53948 [Accessed 26 December 2023]

Lesica, P.; Heidel, B. 1996. Pollination biology of *Silene spaldingii*. Unpublished report to Montana Field Office of The Nature Conservancy. Available at Montana Natural Heritage Program, Helena. Montana. 16 pp.

Lesica, P. 2022. Manual of Montana Vascular Plants. 2nd Edition. Brit Publishing, Texas. 785 pp.

Maglianesi, M.; Bluthgen, N.; Bohning-Gaese, K.; Schleuning, M. 2014. Morphological traits determine specialization and resource use in plant-hummingbird networks in the neotropics. Ecology. 95(12): 3325–3334. Available online: https://esajournals.onlinelibrary.wiley.com/doi/epdf/10.1890/13-2261.1

Montana Natural Heritage Program (MTNHP). 2023a. A query of flowering plant species from the MTNHP Botany Database. December 26. Helena, Montana.

Montana Natural Heritage Program (MTNHP). 2023b. Montana Field Guide profile for *Pseudomasaris vespoides*. Helena, Montana. https://fieldguide.mt.gov/speciesDetail.aspx?elcode=IIHYMJ8040 [Accessed 26 December 2023]

Montana Natural Heritage Program (MTNHP). 2023c. Montana Field Guide profile for *Penstemon lemhiensis*. Helena, Montana. https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PDSCR1L3N0 [Accessed 26 December 2023]

NatureServe Explorer. 2023. Information on *Pseudomasaris vespoides*. Arlington, Virginia. https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.949393/Pseudomasaris_vespoides [Accessed 26 December 2023]

Ollerton, J.; Winfree, R.; Tarrant, S. 2011. How many flowering plants are pollinated by animals? Oikos. 120: 321–326.

Palladini, J. D.; Maron, J. L. 2014. Reproduction and survival of a solitary bee along native and exotic floral resource gradients. Oecologia. 176: 789–798.

Proctor M.; Yeo P.; Lack, A. 1996. The Natural History of Pollination. Portland, OR: Timber Press.

Sagatelova, M.; Rodriguez-Pena, R.; Rodhouse, T.; Lonneker, J.; Sherrill, K.; Wolfe, A. 2023. Conservation Genomics and Species Distribution Models Motivate Proactive and Collaborative Conservation in an Era of Rapid Change. Journal of Bioinformatics and Systems Biology. Volume 6, Issue 3: 263-285. Available online: https://www.fortunejournals.com/articles/conservation-genomics-and-species.pdf

Scheper, J., Bommarco, R.; Holzschuh, A.; Potts, S. G.; Riedinger, V.; Roberts, S. P. M.; Rundlof, M.; Smith, H. G.; Steffan-Dewenter, I.; Wickens, J. B.; Wickens, V. J.; Kleijn, D.; Diamond, S. 2015. Local and landscape-level floral resources explain effects of wildflower strips on wild bees across four European countries. Journal of Applied Ecology. 52: 1165–1175.

Starkey, P. (editor). 2015. Featured Creature. Winter/Spring. Upper Columbia Basin Network Basin Bulletin, Volume 9, Issue 1. National Park Service, Upper Columbia Basin Network, Moscow, Idaho. Available online: http://npshistory.com/newsletters/basin-bulletin/v9n1.pdf [Accessed 14 November 2023]

Stucki, D. S.; Rodhouse, T. J.; Lyon, J. W.; Garrett, L. K. 2013. Natural resource conservation in a cultural park: Evaluating the importance of Big Hole National Battlefield to the endemic Lemhi penstemon (*Penstemon lemhiensis*). Natural Areas Journal. 33: 50–58.

Tallamy, D. 2009. Bringing Nature Home. Timber Press, Oregon. Pp. 360.

Tepedino, V. J.; Sipes, S. D.; Barnes, J. L.; Hickerson, L. L. 1997. The need for "extended care" in conservation: Examples from studies of rare plants in the western United States. ISHS Acta Horticulturae 437: VII International Symposium on Pollination. Available online: doi.org/10.17660/ActaHortic.1997.437.27

Thomson, D. 2016. Local bumble bee decline linked to recovery of honeybees, drought effects on floral resources. Ecology Letters. 15: 1247–1255.

Thomson, D. 2006. Detecting the effects of introduced species: A case study of competition between *Apis* and *Bombus*. Oikos, 114: 407–418.

Thomson, D. 2004. Competitive interactions between the invasive European honeybee and native bumble bees. Ecology. 85: 458–470.

Tufts Pollinator Initiative. Pollinators: Available online: https://sites.tufts.edu/pollinators/2021/04/the-right-way-to-leave-stems-for-native-bees/ [Accessed 16 May 2023]

National Park Service Inventory and Monitoring. 2014. "Lemhi penstemon monitoring at Big Hole National Battlefield" YouTube, December 12, 2014. Available online: https://www.youtube.com/watch?v=EqppGx7Wv-s

Valdovinos, F. S.; Brosi, B. J.; Briggs, H. M.; Moisset de Espanés, P.; Ramos-Jiliberto, R.; Martinez, N. D.; 2016. Niche partitioning due to adaptive foraging reverses effects of nestedness and connectance on pollination network stability. Ecology Letters. 19: 1277–1286.

Wei, N.; Kaczorowski, R. L.; Arceo-Gómez, G.; O'Neill, E. M.; Hayes, R. A.; Ashman, T. L. 2021. Pollinators contribute to the maintenance of flowering plant diversity. Nature. 597: 688–692. Available online: https://www.nature.com/articles/s41586-021-03890-9

APPENDIX A

Conservation Profiles for Plant Species of GCN

CONSERVATION PROFILE:
SAPPHIRE ROCKCRESS (*BOECHERA FECUNDA*)

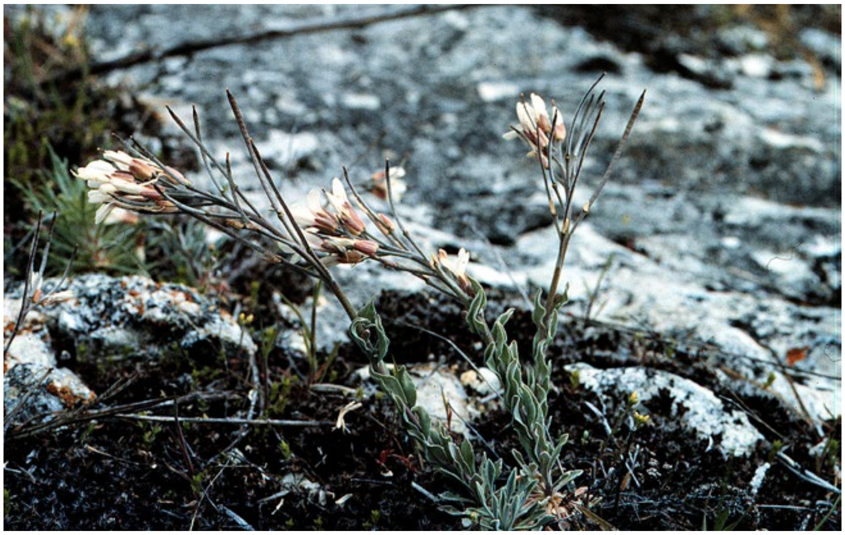
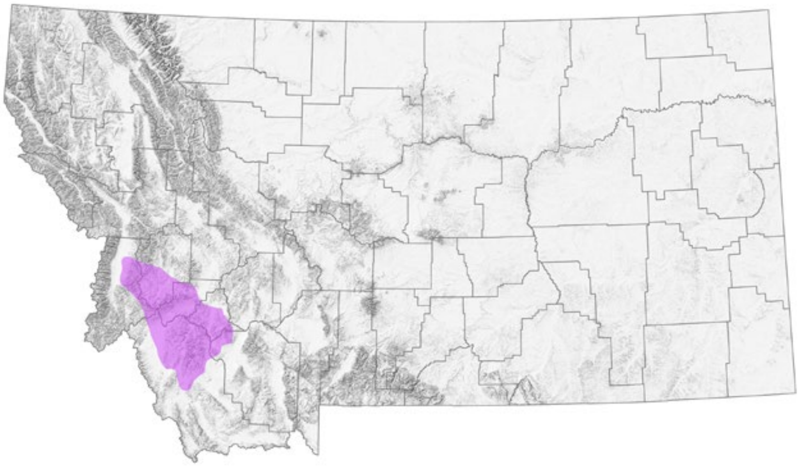


Photo Credit: Peter Lesica

Photo 1. Sapphire Rockcress is only found in Montana (endemic). The species was first described from specimens collected in Ravalli County (type collection).



Source: Montana Natural Heritage Program (2024a)

Figure 1. The range for Sapphire Rockcress in Montana.

PURPOSE:

This conservation profile provides information about Sapphire Rockcress, a Plant Species of Greatest Conservation Need (GCN) in Montana. It highlights the plant's state-level distribution; factors that put it at risk for loss; and conservation objectives that, if implemented, would aid the persistence of Sapphire Rockcress. This conservation profile aims to be an abbreviated, stand-alone document that can be used by, or shared with, land managers, landowners, educators, decision-makers, regulators, and anyone interested in Sapphire Rockcress. This conservation profile should also be used in conjunction with Section 4 of the Montana Native Plant Conservation Strategy which addresses overarching conservation objectives for Plant Species of GCN.

INFORMATION ON SAPPHIRE ROCKCRESS

Distribution, Status, and Identification

Sapphire Rockcress (*Boechera fecunda*) is endemic to Montana, where, on a worldwide scale, it is only found in particular locations within southwest Montana (Lesica 2022) (Photo 1; Figure 1). Sapphire Rockcress is restricted to a metamorphosed limestone habitat, which is designated as a Unique Habitat of Greatest Conservation Need (GCN)[1].

Globally Sapphire Rockcress is ranked by NatureServe as a G2 indicating it is at high risk of global extinction due to a restricted range, few populations, steep declines, severe threats, or other factors (NatureServe 2024). In Montana, Sapphire Rockcress is a Species of Concern (SOC) plant as determined by the Montana Natural Heritage Program (MTNHP) (2024a). Ranked in the state as an S2, Sapphire Rockcress is at high risk because of a restricted range, very few populations or occurrences, threats, and other factors (MTNHP 2024a). Sapphire Rockcress is also designated as a sensitive species on the Beaverhead National Forest (BHDL NF) and with the Montana/Dakotas Bureau of Land Management (MT/Dakotas BLM).

Learn about Sapphire Rockcress identification, biology, and state status in the Montana Field Guide[2].

RATIONALE FOR PLANT SPECIES OF GREATEST CONSERVATION NEED

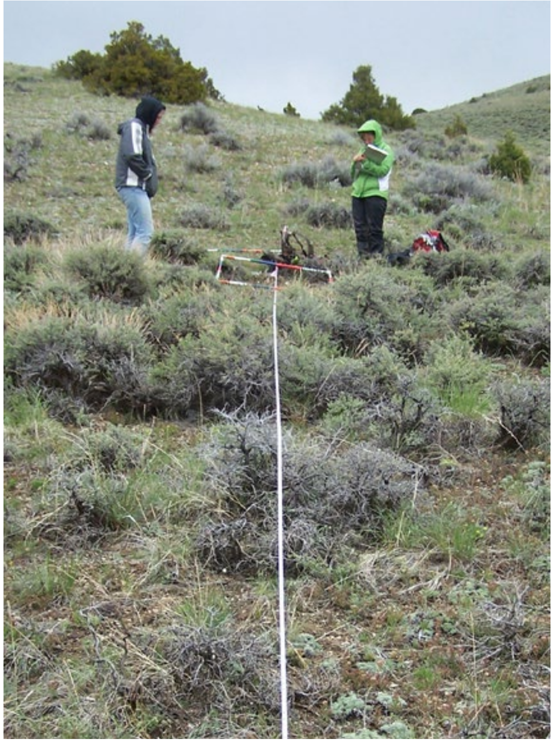


Photo Credit: Jessie Salix

Photo 2. Botanists monitor Saphhire Rockcress on the Beaverhead-Deerlodge National Forest.

Sapphire Rockcress is a Plant Species of Greatest Conservation Need (GCN) in Montana because of its rarity, affinity to a Unique Habitat of GCN, and threats. Plants are only found on metamorphosed limestone habitat which occurs in rare locations of southwest Montana (MTNHP 2024b). As a result, plant populations are relatively few and widely separated (MTNHP 2024a). Sapphire Rockcress is facing direct threats from invasive, non-native plants and advanced succession, and indirect threats from ecologically incompatible livestock grazing and recreational use (MTNHP 2021). Invasive non-native plant species can detrimentally affect native plants by altering pollinator behavior, competing for water and nutrients, and altering ecosystem attributes, such as microclimates, fire ecology, hydrology, and nutrient cycling. Spotted Knapweed (*Centaurea stoebe*), a noxious weed, occurs at some Sapphire Rockcress occurrences and has been shown to suppress seed germination and establishment (Lesica and Shelly 1991 and 1996). Vegetation succession at the Birch Creek and possibly the Cattle Gulch occurrences is resulting in an establishment of conifers; however, the cause is unknown because metamorphosed limestone habitat is not thought to be maintained by natural fire regimes. Livestock grazing occurs at most sites. When not managed properly, livestock grazing can trample plants, break up biological soil crusts, and become a vector for non-native plant species. A study conducted at Charley's Gulch and Lime Gulch found a positive association between the presence of biological soil crust and the presence of Sapphire Rockcress plants (Lesica and Shelly 1992). Recreational use of metamorphosed limestone for rock climbing has increased at some sites.

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[1] Refer to the *Montana Native Plant Conservation Strategy*, Section 5-Unique Habitats of GCN and Appendix B-Metamorphosed Limestone Unique Habitat of GCN.

[2] Montana Field Guide, Sapphire Rockcress: https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PDBRA06290

CONSERVATION GOALS & OBJECTIVES FOR SAPPHIRE ROCKCRESS

The intent of the *Montana Native Plant Conservation Strategy: Vascular Species and Habitats of GCN* is to promote the collective and coordinated stewardship of Montana's Plant Species of GCN to ensure their viability and persistence using a fusion of approaches. Sections 3-*Strengthening Botanical Capacity* and 4-*Plant Species of GCN* present overarching goals and conservation objectives that can indirectly help sustain Sapphire Rockcress populations. In this profile we present conservation objectives specific to Montana's Sapphire Rockcress populations from four areas that are pillars to plant conservation:

- Information Needs [Inventory, Monitoring, Research]
- Protection and Restoration
- Outreach and Education
- Policy and Regulation

The conservation objectives were developed by a Sapphire Rockcress Working Group that met in spring 2022, and are based on published research, monitoring, professional expertise, and field observations. The working group consisted of botanists, ecologists, a rangeland specialist, a consulting botanist, and retired professionals from the US Forest Service (Region 1 and BHDL NF), MT/Dakotas BLM, and private sectors (see Table 1 on page *iii* of the *Strategy*). Working within and across jurisdictional boundaries, these voluntary conservation objectives are intended to empower federal, state, and non-government conservation land managers, and landowners who want to contribute to or collaborate on processes that could aid Sapphire Rockcress persistence on the landscape. These voluntary actions can be pursued or implemented by a single entity, or as a collaborative effort by individuals, agencies, and organizations. They are presented in no prioritized order.

Photo Credit: Lauren Carley

Photo 3. Basal rosettes of Sapphire Rockcress, a long-lived perennial plant.

Information Needs [Inventory, Monitoring, Research]

Conservation Goal

Improve scientific understanding of Sapphire Rockcress in Montana and the ecological and cultural processes that sustain plants and habitat through statewide coordination, inventory, monitoring, and research.

Conservation Objectives

1) Work collaboratively with federal agencies, NGOs, and other organizations to acquire necessary field data and share the information with MTNHP to conduct the following assessments:

   a. Review and revise Species Occurrence Ranks (SO-Ranks). An SO-Rank represents the overall "quality" of the site based on an assessment of the plant's population size, habitat quality, landscape context, and abiotic and biotic conditions. Updated and accurate SO-Ranks are used by managers in planning projects, prioritizing occurrences for restoration, identifying reference sites, and aiding management decisions. SO-Ranks should be reviewed and revised on a five- to ten-year cycle.

   Box 1. Status of SO-Ranks for approximately 68 extant Sapphire Rockcress occurrences as of 2023:

   - 8 lack SO-Rank
   - 60 ranked in 2009

   As of 2023, 88% of extant Sapphire Rockcress occurrences were ranked in 2009, and are in need of a re-assessment, and 12% are in need of a full assessment (Box 1). Acquiring revisit data on SOs and updating SO-Ranks at regular intervals creates a tool for inferring trend (stable, improving, or degrading) for the site.

   b. Evaluate and update State Threat Score and rationale. Sapphire Rockcress has a State Threat Score of medium based on the 2021 Threat Assessment (MTNHP 2021)[1]. The State Threat Score and rationale should be updated by MTNHP at five-year intervals, or as warranted by current data. Reported threats and data analysis should be posted on the Montana Field Guide to create transparency in the ranking process. The State Threat Score represents the degree to which the target plant is degraded by extrinsic factors, which are characterized in terms of threat type timing, severity, and scope (MTNHP 2021).

2) Develop working relationships with private landowners who have Sapphire Rockcress plants on their properties. Facilitate conversations with the landowners about their concerns, observations and knowledge of the plant, permissions to access habitat, ability to conduct revisits or acquire plant counts and habitat condition data, and address other needs. Consider providing survey results (both present and absent observations) to MTNHP for inclusion in the botany database.

3) Collaborate with private landowners to seek input and permissions to conduct surveys on lands identified as high or moderate suitability by the most current Predicted Suitable Habitat Model. Consider providing survey results (both present and absent observations) to MTNHP to help refine the Predicted Suitable Habitat Model for Sapphire Rockcress in Montana.

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[1] Sapphire Rockcress profile, Montana Field Guide: https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PDBRA06290

Information Needs [Inventory, Monitoring, Research]

4) For established plots at the Birch Creek/Lime Gulch, Vipond Park, and Canyon Creek populations in the BHDL NF, support the ongoing data (population monitoring and trend assessments) collection, mapping, data analysis, and reporting. Share results with the MT/Dakotas BLM-Dillon Field Office, MTNHP, private landowners, and other pertinent conservation organizations.

Canyon Creek
BOFE
9-204°
7/3/21

Photo Credit: Jessie Salix

Photo 4. Monitoring Saphhire Rockcress in the Canyon Creek occurrence on the Beaverhead-Deerlodge National Forest.

5) Collaborate with all federal and private landowners to acquire revisit data from known Sapphire Rockcress occurrences on a frequency of at least once every ten years. Revisits could be coordinated with a Montana Citizen Botany Program (see also Section 3, Information Needs, Conservation Objective #4). Consider providing survey results (both present and absent observations) to the MTNHP botany database.

6) Determine whether plant specimens should be collected to ensure that the species' distribution, genetics, and morphology is adequately preserved in a state herbarium. If warranted, specimens could be deposited at the University of Montana (MONTU), Montana State University (MONT), and/or Montana State University-Billings (MSUB) herbaria.

7) Develop a monitoring study to measure the establishment of conifers within Birch Creek and Cattle Gulch Areas.

8) Encourage research and awareness through collaboration with the BHDL NF, MT/Dakotas BLM-Dillon Field Office, and the Montana University System.

9) Use existing resources to find literature, research studies, and other information when investigating research questions or needs and designing monitoring studies. Reference material - already compiled can be found at:
   - Cited and Additional References section in the Montana Field Guide Sapphire Rockcress profile[1]

10) Research topics that could further our understanding of this unique plant and/or assist in plant conservation efforts include, but are not limited to:
    - Develop and conduct studies that examine pollination biology.

Protection and Restoration

Conservation Goal

Secure on-the-ground, site-specific habitat and/or management protection or restoration for Sapphire Rockcress on public and private lands.

Conservation Objectives

1) If established monitoring on the Beaverhead-Deerlodge National Forest indicates a potential or real downward trend, then develop an interagency conservation strategy for Sapphire Rockcress.
2) Develop partnerships between federal, state, non-profit, and/or private organizations within the Montana range for Sapphire Rockcress and the following potential facilities to conduct seed banking, germination trials, genetic research, and/or related topics relative to collected plant materials:
    - Rae Selling Berry Seed Bank, Portland State University, Oregon[3]
    - Plant Germplasm Introduction Test and Research Unit, Pullman, Washington
3) Implement the Cattle Gulch Weed Management Plan to control invasive non-native plants, specifically from Spotted Knapweed (*Centaurea stoebe*), Musk Thistle (*Carduus nutans*), and Hound's-Tongue (*Cynoglossum officinale*) that have invaded the bottom of the draw and could potentially move upslope to Sapphire Rockcress populations.

Outreach and Education

Conservation Goal

Facilitate the stewardship of Sapphire Rockcress populations and habitat through education, outreach, and coordination.

Conservation Objectives

1) Revise the Sapphire Rockcress profile on the *Montana Field Guide* to current MTNHP standards to update and expand known information on life history, ecology, fire ecology, population counts and trends, genetics, germination, transplant experiments, pollination biology, identification, biological characteristics, economics, rangeland management, threats, taxonomy, and other interesting facts; create links to the *Strategy* and other online information; and improve readability.
2) Through the Montana Native Plant Society, conduct field trips to known Sapphire Rockcress sites to increase public awareness of the plant, its habitat, and status, and garner public support for it as a Plant Species of GCN.
3) Update information on the developing Montana Native Plant Conservation Strategy webpage hosted on the Montana Natural Heritage Program's website[4].
4) Work with US Forest Service staff and other conservation organizations to assess the interpretive sign at Vipond Park[5] to determine its condition and the need to update

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[3] Rae Selling Berry Seed Bank: https://www.pdx.edu/seed-bank/

[4] Montana Natural Heritage Program: https://mtnhp.mt.gov/

[5] Vipond Park: https://www.fs.usda.gov/wildflowers/regions/northern/VipondPark/index.shtml

Outreach and Education

information relative to Sapphire Rockcress and Metamorphosed Limestone Unique Habitats of GCN. Interpretive signs that are maintained and updated can give recreational users a sense of place, enhance their experience, and garner support for rare plants, unique habitats, and other stewardship activities.

Policy and Regulation

Conservation Goal

Improve conservation of Sapphire Rockcress through public participation and implementation of existing policies and regulations in cooperation with federal agencies, private landowners, and other interested stakeholders.

Conservation Objectives

1) Advocate for the Beaverhead-Deerlodge NF and Region 1 of the USFS to finalize the proposed establishment of the Cattle Gulch RNA.
2) Continue efforts that comply with the 2009 Beaverhead-Deerlodge Forest Revised Forest Plan (USDA 2009) for Sensitive plant populations and their habitats: "Assess the status and work towards the goal that large core populations and/or fringe populations of *Boechera fecunda* are conserved in RNAs, botanical special interest areas, or protected as populations in conservation strategies or through project design specifications on the Beaverhead-Deerlodge National Forest."
3) Continue efforts that comply with the BLM Resource Management Plan for Sensitive plant populations and their habitats (USDA 2006 and 2020). These efforts are to:
   - Identify, conserve, and monitor rare, vulnerable, and representative habitats, plant communities, and ecosystems to ensure that there is a self-sustaining persistence of special status plants within the BLM Dillon Field Office.
   - Ensure that proposed land uses initiated or authorized by BLM avoid inadvertent damage to federal and non-federal habitats supporting special status plants and plant communities.
   - Promote public awareness, appreciation and understanding of rare plants and their habitats.
4) Support the preservation and use of Research Natural Areas designated by the US Forest Service-Region 1. Readers are encouraged to consult the general technical report titled, "Research Natural Areas on National Forest System Lands in Idaho, Montana, Nevada, Utah, and Western Wyoming: A Guidebook for Scientists, Managers, and Educators" (Evenden et al. 2001).

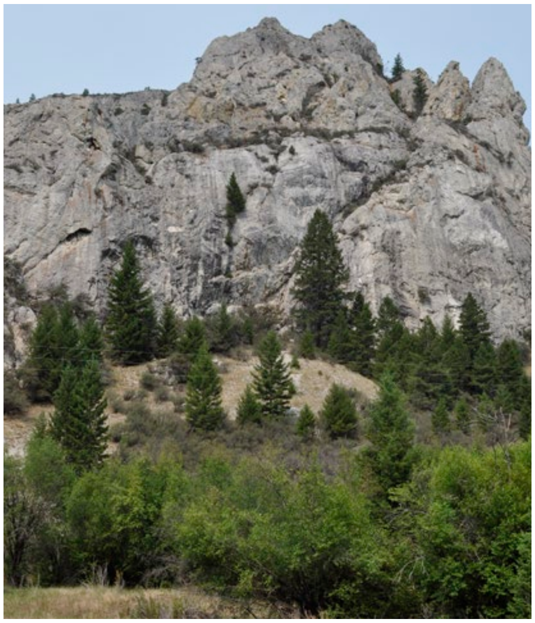

Photo Credit: Andrea Pipp

Photo 5. Metamorphosed Limestone outcrops are visible on the landscape from afar. The calcareous sandy or silty loams provide proper soil conditions for Sapphire Rockcress.

REFERENCES

Lesica, Peter, Matt T. Lavin, and Peter F. Stickney. 2022. *Manual of Montana Vascular Plants*, 2nd Edition. Fort Worth, TX: BRIT Press.

Lesica, Peter. and J. Stephen Shelly. 1991. The effect of the introduced weed *Centaurea maculosa* on *Arabis fecunda*, a threatened Montana endemic. Prepared for Montana Natural Heritage Program, Helena, MT. 15 pp. plus appendix.

Lesica, Peter. and J. Stephen Shelly.1992. "Effects of cryptogamic soil crust on the population dynamics of *Arabis fecunda* (Brassicaceae)." *American Midland Naturalist* 128(1): 53-60.

Lesica, Peter. and J. Stephen Shelly. 1996. "Competitive effects of Centaurea maculosa on the population dynamics of *Arabis fecunda*." *Bulletin of the Torrey Botanical Club* 123(2):111-121.

Montana Natural Heritage Program (MTNHP). 2021. An assessment of threat data reported for *Boechera fecunda*. MTNHP Botany Database. Helena, MT.

Montana Natural Heritage Program (MTNHP). 2024a. Observation and species level data on *Boechera fecunda*. Botany Database. Helena, MT. [Accessed 29 April 2024]

Montana Natural Heritage Program (MTNHP). 2024b. *Boechera fecunda* profile in the *Montana Field Guide*. https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PMORC2B100 [Accessed 28 April 2024]

Evenden, Angela G.; Moeur, Melinda; Shelly, J. Stephen; Kimball, Shannon F.; Wellner, Charles A. 2001. Research Natural Areas on National Forest System Lands in Idaho, Montana, Nevada, Utah, and Western Wyoming: A Guidebook for Scientists, Managers, and Educators. Gen. Tech. Rep. RMRS-GTR-69. Ogden, UT: US. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 84 pp.

NatureServe Explorer. 2024. Global Rank for *Boechera fecunda*. https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.159353/Boechera_fecunda [Accessed 6 July 2024]

US Department of Agriculture (USDA), Forest Service. 2009. Beaverhead-Deerlodge National Forest Land and Resource Management Plan. Dillon, MT: USDA, Forest Service, Beaverhead-Deerlodge National Forest. 504 p.

US Department of Interior (USDA), Bureau of Land Management. 2006. Record of Decision and Approved Dillon Resource Management Plan. Dillon Field Office, Dillon, MT.

US Department of Interior (USDA), Bureau of Land Management. 2020. Montana/Dakotas Special Status Species List. Instructional Memorandum No. MT-2020-012.

CONSERVATION PROFILE:
WATER HOWELLIA (*HOWELLIA AQUATILIS*)

Photo Credit: Scott Mincemoyer

Photo Credit: Rebecca Durham

Photos 1 and 2. Water Howellia (inset) growing in its vernal pool habitat on the Flathead National Forest.

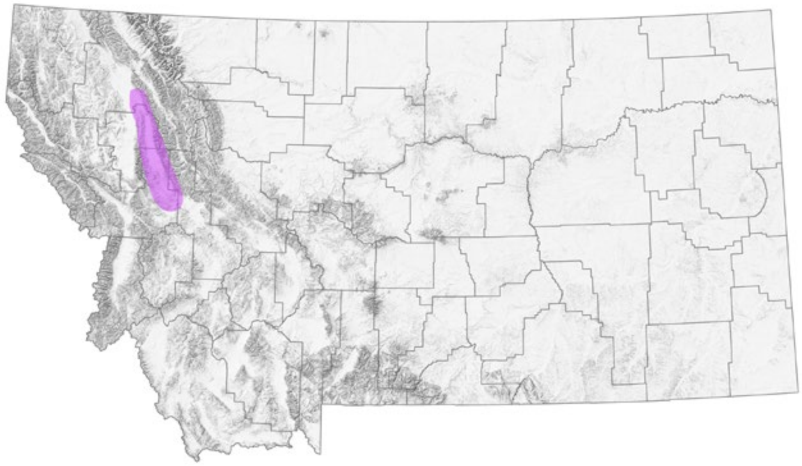
Source: Montana Natural Heritage Program (2024a)

Figure 1. The range for Water Howellia in Montana.

PURPOSE:

This conservation profile provides information about Water Howellia, a Plant Species of Greatest Conservation Need (GCN) in Montana. It highlights the plant's state-level distribution; factors that put it at risk for loss; and conservation objectives that, if implemented, would aid the persistence of Water Howellia. This conservation profile aims to be an abbreviated, stand-alone document that can be used by, or shared with, land managers, landowners, educators, decision-makers, regulators, and anyone interested in Water Howellia. This conservation profile should also be used in conjunction with Section 4 of the Montana Native Plant Conservation Strategy which addresses overarching conservation objectives for Plant Species of GCN.

INFORMATION ON WATER HOWELLIA

Distribution, Status, and Identification

Water Howellia (*Howellia aquatilis*) is endemic to the US where, on a worldwide scale, it is sparsely found in the Pacific Northwest (Photos 1a/b) (USFWS 2021). In Montana, Water Howellia was first documented in 1978 growing in a vernal pond. Since then plants have been found in numerous vernal ponds and in a few old river oxbows, but all within the Swan Valley (Figures 1 and 2) (Mincemoyer 2005; MTNHP 2024a).

In 1994 Water Howellia was federally listed as a threatened species under the Endangered Species Act (ESA) of 1973, as amended, by the US Fish and Wildlife Service (USFWS) (59 FR 35860; USFWS 1994). A draft recovery plan was prepared for the USFWS, but never finalized (USFWS 1996). Listing facilitated surveys and research, bringing forth a great amount of information on the plant's life history, ecological needs, and ways to manage its persistence. The Flathead National Forest developed a conservation strategy (USFS 1997) and established collaborative long-term monitoring studies with state and private land managers. In 2021 Water Howellia was removed from the list of threatened and endangered species under the ESA because collaborative conservation efforts resulted in additional species occurrence locations, land ownership transfers, and long-range land management plans (USFWS 2021). Delisting triggered implementation of the Water Howellia Post-Delisting Monitoring plan, which is being implemented across its range through the year 2036 (USFWS 2020).

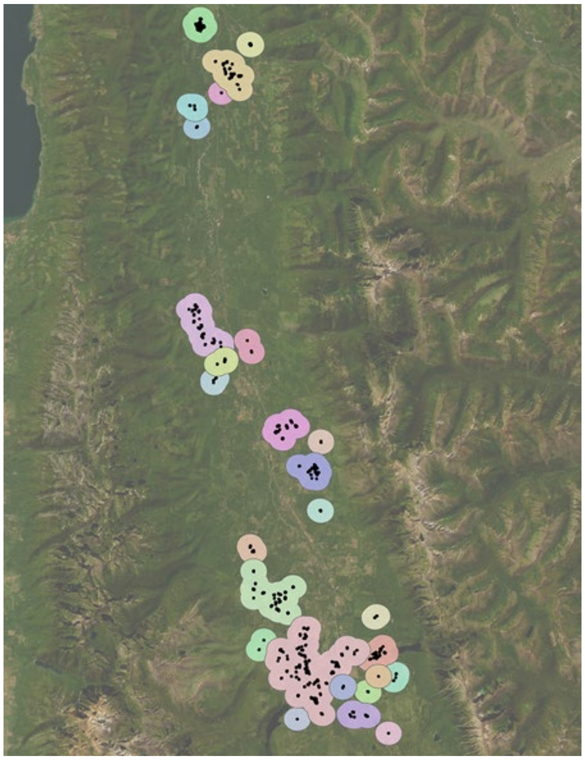

Figure 2. The distribution of Water Howellia occurrences within the Swan Valley of Montana (MTNHP 2024a). Black dots represent Species Occurrences (SOs) as mapped by MTNHP. Colored polygons that encapsulate them represent Element Occurrences (EOs) based on NatureServe methods.

Water Howellia is a Montana Species of Concern (SOC) plant as determined by the Montana Natural Heritage Program (MTNHP) (2024b). Ranked in the state as an S3, Water Howellia is vulnerable to extirapation because of a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats or other factors (Montana Natural Heritage Program [MTNHP] 2024a).

Learn about Water Howellia identification, biology, and state status in the Montana Field Guide[1]

Learn about Water Howellia range-wide information and federal status in the USFWS Environmental Conservation Online Systems (ECOS)[2]

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[1] *Montana Field Guide*, Water Howellia: https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PDCAM0A010

[2] USFWS ECOS website: https://ecos.fws.gov/ecp/species/7090

RATIONALE FOR PLANT SPECIES OF GREATEST CONSERVATION NEED

Water Howellia is a Plant Species of Greatest Conservation Need (GCN) in Montana because of its rarity, habitat specificity, and potential threats to its persistence. In the state, Water Howellia is only found in the Swan Valley. Plants depend on a hydrologic cycle whereby vernal ponds fill in the spring from snowmelt, precipitation, and groundwater, and partially or completely recede by autumn in most years (Mincemoyer 2005; USFS 1997). Being an aquatic winter annual, plants grow, flower, and set seed when inundated by water. As the ponds dry, seeds germinate only after being exposed to air and fluctuating temperatures (USFS 1997). Obtaining accurate population data can be a challenge because abundance is partially dependent upon environmental conditions and can vary greatly from year to year (Mincemoyer 2005).

Water Howellia populations are vulnerable to actions that negatively impact its restricted habitat, annual lifecycle, or vernal pond hydrology (MTNHP 2021; Mincemoyer 2005). Montana boasts the largest population of the species across its worldwide range, and its persistence has been helped by improved land stewardship and possibly by a mosaic landscape (Mincemoyer 2005; Pipp 2017). Yet, potential threats to the persistence of Water Howellia populations remain ever-present from invasive aquatic plants, land development, and ground-disturbing activities that can alter water quantity, quality, or cycling (MTNHP 2021; Pipp 2017; Mincemoyer 2005; USFS 1997).

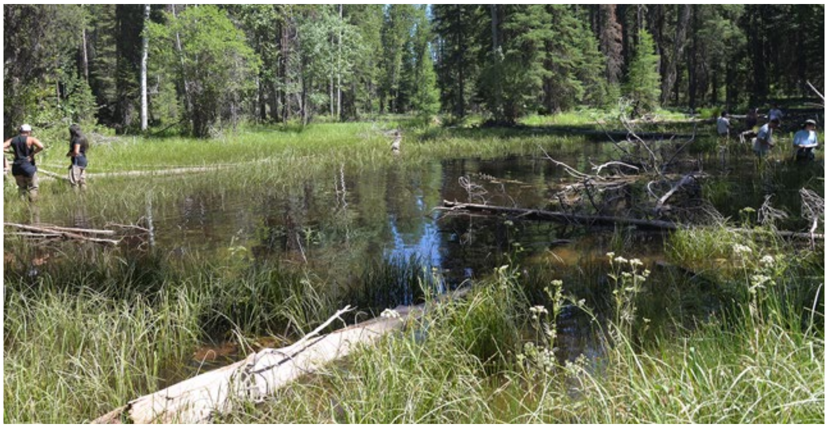
Photo Credit: Andrea Pipp

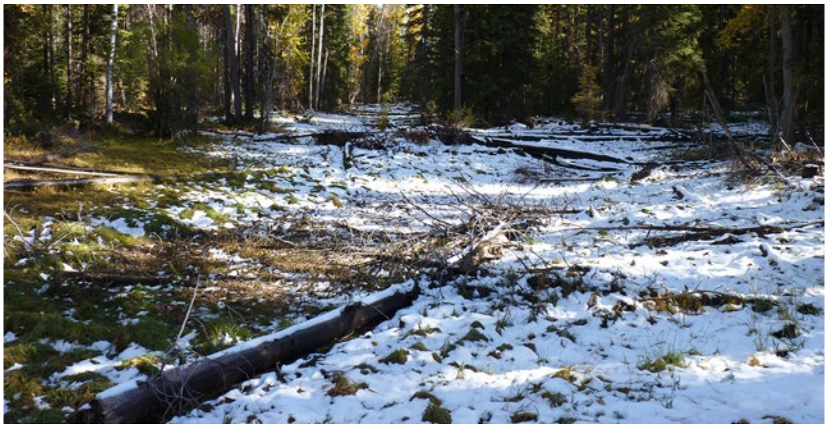
Photo Credit: Steve Shelly

Photos 3 and 4. The vernal pond fills in the spring from snowmelt, precipitation, and groundwater (upper) and dries partially to fully by late summer (lower). Swan Valley, Montana.

CONSERVATION GOALS & OBJECTIVES
FOR WATER HOWELLIA

The intent of the *Montana Native Plant Conservation Strategy: Species and Habitats of GCN* is to promote the collective and coordinated stewardship of Montana's Plant Species of GCN to ensure their viability and persistence using a fusion of approaches. Sections 3-*Strengthening Botanical Capacity* and 4-*Plant Species of GCN* present overarching goals and conservation objectives that indirectly can help sustain Water Howellia populations. In this profile we present objectives specific to Montana's Water Howellia populations from four areas that are pillars to plant conservation:

- Information Needs [Inventory, Monitoring, Research]
- Protection and Restoration
- Outreach and Education
- Policy and Regulation

The conservation objectives were developed by a Water Howellia Working Group that met in November 2022, and are based on published research, monitoring, professional expertise, and field observations. The working group consisted of staff from federal and state land management agencies, consulting businesses, the Montana Natural Heritage Program, the Montana Native Plant Society, and retired researchers and land management professionals (see Table 1 on page *iii* of the *Strategy*). Working within and across jurisdictional boundaries, these voluntary conservation objectives are intended to empower federal, state, and non-government conservation land managers, landowners, businesses, and individuals who want to contribute to or collaborate on processes that could aid Water Howellia persistence on the landscape. These voluntary actions can be pursued or implemented by a single entity, or as a collaborative effort by individuals, agencies, and organizations. They are presented in no prioritized order.

Information Needs [Inventory, Monitoring, Research]

Conservation Goal

Improve scientific understanding of Water Howellia in Montana, and the ecological processes that sustain plants and habitat through statewide coordination, inventory, monitoring, and research.

Conservation Objectives

1) Work collaboratively with state agencies, private landowners, NGOs, and other organizations to acquire necessary field data and share the information with MTNHP to conduct the following assessments:
    a. Review and Revise Species Occurrence Ranks (SO-Ranks). An SO-Rank represents the overall "quality" of the site based on an assessment of the plant's population size, habitat quality, landscape context, and abiotic and biotic conditions. Updated and accurate SO-Ranks are used by managers in planning projects, prioritizing occurrences for restoration, identifying reference sites, and aiding management decisions. SO-Ranks should be reviewed and revised on a five-to ten-year cycle.

Information Needs [Inventory, Monitoring, Research]

As of 2023, 78% of extant Water Howellia occurrences were ranked in 2009, and are in need of a re-assessment, and 22% are in need of a full assessment (Box 1). Acquiring revisit data on SOs and updating SO-Ranks at regular -intervals creates a tool for inferring trend (stable, improving, or degrading) for the site.

Box 1. Status of SO-Ranks for 232 extant Water Howellia occurrences as of 2023:

- 51 lack SO-Rank
- 181 ranked in 2009

b. Evaluate and Update State Threat Score and rationale. Water Howellia has a State Threat Score of high-medium based on the 2021 Threat Assessment (MTNHP 2021a). The State Threat Score and rationale should be updated by MTNHP at five-year intervals, or as warranted by current data. Reported threats and data analysis should be posted on the Montana Field Guide to create transparency in the ranking process. The State Threat Score represents the degree to which the target plant is degraded by extrinsic factors, which are characterized in terms of timing, severity, and scope (MTNHP 2021b; Master et al. 2012).

2) Collaborate with landowners to seek input and permissions to conduct consecutive years of surveys on lands identified as having high, moderate, or low suitability by the most current Predicted Suitable Habitat Model. Consider providing survey results (both present and absent observations) to MTNHP to help refine the Predicted Suitable Habitat Model for Water Howellia in Montana. Based on presence/absence data reported from 1978 to 2017, two consecutive years of survey are needed to detect the presence of the plant approximately 86% of the time (MTNHP 2017). Landowners with whom to collaborate include:

- Private landowners
- NGO landowners, specifically The Nature Conservancy
- State land management agencies, specifically MT DNRC
- Federal land management agencies, specifically Flathead National Forest (NF), Lolo NF, Swan River National Wildlife Refuge

3) Where known Water Howellia populations occur, collaborate with landowners to seek input and permissions to acquire data or conduct consecutive years of surveys at least once in a 10-year period - to obtain current data on population size, threats, and habitat condition and to track trends. Consider providing survey results (both present and absent observations) to MTNHP for inclusion into the botany database. Based on presence/absence data

Photo Credit: Andrea Pipp

Photo 5. A member of the Mission Mountains Youth Crew successfully finds Water Howellia during a plant survey.

reported from 1978 to 2017, two consecutive years of survey are needed to detect the presence of the plant approximately 86% of the time (MTNHP 2017). Landowners with whom to collaborate - include:

- Private landowners
- NGO landowners, specifically The Nature Conservancy (TNC)
- State land management agencies, specifically MT DNRC
- Federal land management agencies, specifically Flathead National Forest (NF), Lolo NF, Swan River National Wildlife Refuge (NWR)

Photo Credit: Kristi DuBois

Photo 6. The tiny, white flowers of Water Howellia peep just above the water surface.

4) For ponds categorized as unoccupied (U-Pond) by the 1998-2012 monitoring studies (MTNHP 2024a), collaborate with landowners to seek input and permissions to acquire data or conduct consecutive years of surveys at least once in a 10-year period in assess Water Howellia occupancy and potential habitat condition. Unoccupied ponds that were surveyed and determined to have potential habitat were categorized as U-Ponds and may serve as future refugia for Water Howellia. Consider providing survey results (both present and absent observations) to MTNHP for inclusion into the botany database. Based on presence/absence data reported from 1978 to 2017, two consecutive years of survey are needed to detect the presence of the plant approximately 86% of the time (MTNHP 2017). Landowners with whom to collaborate - include:
   - Private landowners
   - NGO landowners, specifically TNC
   - State land management agencies, specifically MT DNRC
   - Federal land management agencies, specifically Flathead NF, Lolo NF, Swan River NWR

5) For Water Howellia occurrences that are part of the established Post-Delisting Monitoring Plan, maintain collaboration among the USFWS, USFS, and MTNHP and retain the monitoring schedule and data collection methods. Also, acquire any funds needed to complete the required work in 2028 and 2029 (years 7-8) and in 2035-2036 (years 14-15) and comply with the ESA (USFWS 2020). The 2022-2023 baseline monitoring dataset consists of 30 mandatory and approximately 24 optional ponds to monitor (MTNHP 2024a).

6) For Water Howellia occurrences that are not part of the established Post-Delisting Monitoring Plan implementation, work cooperatively with federal and state agencies, NGO land managers, and private landowners to conduct revisits for the purpose of acquiring current plant population and habitat data. Consider providing survey results (both present and absent observations) to MTNHP for inclusion in the botany database. Based on presence/absence data reported from 1978 to 2017, two consecutive years of survey are needed to detect the presence of the plant approximately 86% of the time (MTNHP 2017).

Information Needs [Inventory, Monitoring, Research]

7) For each Water Howellia occurrence, strive to obtain population presence and absence, habitat, threat, and mapping data at least once every ten years and share data with the MTNHP. Maintaining current and accurate information on each Water Howellia occurrence helps maintain accurate information for use in status assessment, projects, and planning efforts.

8) Use existing resources to find literature, research studies, and other information when investigating research questions or needs and designing monitoring studies. Across Water Howellia range information has accumulated from a variety of sources including academic research, federal and state research and management reports, and observation data, on topics of life history traits, ecology and habitat requirements, germination, growth, and transplanting, pollinators, livestock grazing and management, fire ecology, and others. Reference material - already compiled can be found at the following sources:
   - Cited and Additional References section in the Montana Field Guide Water Howellia profile[1]
   - USFWS ECOS website[2]

9) Research topics that could further our understanding of this unique plant and/or help plant conservation efforts include, but are not limited to:
   a. Conduct research on seed collection, storage techniques, and germination trials for incorporating into a seed bank. Refer also to Section 4, Protection and Restoration Conservation Objective #7.

   b. Develop studies that examine the effects of fire on vernal pond hydrology (groundwater processes). Refer also to "An analysis of disturbance buffers surrounding occupied Water Howellia (*Howellia aquatilis*) ponds and unoccupied ponds in Montana (Pipp 2017).

   c. Develop studies to examine the effects of silvicultural treatments on Water Howellia populations and vernal pond hydrology (groundwater processes).

   d. Conduct studies relative to pollinators for Water Howellia.

   e. Conduct study mechanisms of seed dispersal for Water Howellia. Readers should also consult the Flathead NF Conservation Strategy for Water Howellia (USFS 1997).

   f. Use a research-based monitoring study to examine the effect of drafting water from vernal ponds on Water Howellia population ecology.

   g. Conduct research to determine the cytotype of Reed Canarygrass (*Phalaris arundinacea*) in the Swan Valley. Certain forms of Reed Canarygrass are invasive to native plants and their habitats (Merigliano and Lesica 1998); however, there are currently no techniques for identifying these forms prior to their invasion. Knowing which form of Reed Canarygrass occurs at each Water Howellia occurrence would provide a management tool to assess the actual risk of invasion by Reed Canarygrass and is needed to more accurately assess the State Threat Score. Readers should also consult the Flathead NF Conservation Strategy for Water Howellia (USFS 1997).

Information Needs [Inventory, Monitoring, Research]

h. Study the successional dynamics of the surrounding upland forests in the Swan Valley and determine how Water Howellia is affected by those dynamics. Readers should also consult the Flathead NF Conservation Strategy for Water Howellia (USFS 1997).

i. Determine the relationship between Water Howellia vigor and nutrient availability in pond substrates (USFS 1997). Particular nutrients, such as phosphorus, nitrate, and ammonium, may influence fertility and vigor (Lesica 1990). This type of information could help determine the impact that activities like grazing, roadside fertilizing, and logging may have on Water Howellia populations. Readers should also consult the Flathead NF Conservation Strategy for Water Howellia (USFS 1997).

Protection and Restoration

Conservation Goal

Secure on-the-ground, site-specific habitat and/or management protection or restoration for Water Howellia on public and private lands.

Conservation Objectives

1) Provide incentive-based programs to conserve, enhance, and restore habitats that support Water Howellia. Tools could include long-term conservation leases, conservation easements, grazing system development, seeding projects, invasive species control, and funding mechanisms. Programs that could help include, but are not limited to:
   - USFWS Section 6 Grant Program
   - Montana Fish, Wildlife & Parks (MFWP) Habitat Montana Program[3]
   - Montana Association of Land Trusts[4]
   - Natural Resources Conservation Service (NRCS), Agricultural Conservation Easement Programs (ACEP)[5] for Montana

     -Agricultural Land Easements (ALE)[6]
     -Wetland Reserve Easements (WRE)[7]

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[3] MFWP Habitat Montana: https://fwp.mt.gov/conservation/landowner-programs/habitat-montana
Refer also to Section 3, Protection and Restoration, Conservation Objective #1.

[4] Montana Association of Land Trusts: https://montanalandtrusts.org/

[5] NRCS ACEP: https://www.nrcs.usda.gov/programs-initiatives/acep-agricultural-conservation-easement-program/montana/agricultural

[6] NRCS ACEP - ALE: https://www.nrcs.usda.gov/programs-initiatives/acep-agricultural-conservation-easement-program/montana/agricultural

[7] NRCS ACEP – WRE: https://www.nrcs.usda.gov/programs-initiatives/acep-agricultural-conservation-easement-program/montana/agricultural

2) Develop partnerships between federal, state, non-profit, and/or private organizations within the Montana range for Water Howellia and the following potential facilities to conduct seed banking, germination trials, genetic research, and/or related topics relative to collected Water Howellia plant materials:
   - Rae Selling Berry Seed Bank, Portland State University, Oregon[8]. Study trials in the 1990s showed that Howellia aquatilis seeds are short-lived and live seeds could not successfully be stored with conventional methods (Lesica 1990; USFWS 1998).
   - Plant Germplasm Introduction Test and Research Unit, Pullman, Washington
3) Promote resiliency for the Swan Valley meta-population. Where land is managed, strive to retain or promote a complex mosaic of vernal pond types, hydrologic conditions, and vegetation types and successional stages. It is thought that a landscape that contains different types of vernal ponds with varying hydrological characteristics will help -retain potential habitat for Water Howellia to colonize as the climate changes.
4) Work with local, county, and state transportation agencies to reduce or eliminate roadside applications of herbicide, sanding, or salting along Water Howellia ponds that are within road right-of-ways. Reducing the amount of chemicals and sediment that enter Water Howellia ponds will maintain good water quality.
5) Coordinate with county weed extensions, local watershed groups, and other natural resource service providers in Water Howellia habitat areas to provide information on Water Howellia pond locations and increase awareness.
6) Prevent the introduction or spread of invasive species into vernal pond habitat, regardless of whether the pond is occupied by Water Howellia, by:
   - Not dumping aquarium plants or animals into ponds, rivers, and other aquatic habitats.
   - Monitoring for aquatic invasive plants.
7) Minimize ground disturbance in the upland habitat that surrounds vernal ponds to minimize possible negative impacts to water quality, especially those occupied by Water Howellia.

Photo Credit: Will Schlegel

Photo 7. A USFS Botanist collects baseline data as part of the Post-Delisting Monitoring Plan for Water Howellia. Flathead National Forest, Montana.

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[8] Rae Selling Berry Seed Bank: https://www.pdx.edu/seed-bank/

Outreach and Education

Conservation Goal

Facilitate the stewardship of Water Howellia populations and habitat through education, outreach, and coordination.

Conservation Objectives

Photo Credit: Erica Rudolph

Photo 8. A USFS Botanist surveys for Water Howellia as part of the Post-Delisting Monitoring Plan. Flathead National Forest, Montana.

1) Through educational and conservation NGOs, teach, lead outdoor experiences, and/or develop educational materials to further awareness and conservation efforts relative to Water Howellia or vernal pond habitat. Organizations to partner with include, but are not limited to:
    - Montana Native Plant Society (MNPS)[9]
    - Swan Valley Connections (SVC)[10]
    - Montana Conservation Corps MCC)[11]
    - Mission Mountains Youth Crew, (MMYC)[12] sponsored by Swan Valley Connections, National Forest Foundation, Flathead National Forest, and Salish Kootenai College.
2) Work with educators and plant- and habitat-focused non-profits to incorporate Water Howellia into an education unit on Montana's rare plants or vernal pond ecology for students in primary and secondary schools.
3) Assess the Water Howellia interpretive sign and bench along the Holland Lake nature trail to determine their condition and need for an update. In addition, develop recommendations on how to repair and/or maintain this resource for the short and long term. This interpretive sign and the bench can further Water Howellia conservation by creating a sense of placeand interesting information on a truly unique plant to enhance the recreational user's experience.
4) Tell the story of Water Howellia, its unique life history and habitat, and the conservation practices that have led to de-listing it from the ESA by writing articles, conducting field trips, presenting talks, and developing stories for news, social, and web media. Pair people who are knowledgeable about Water Howellia with writers, conservation-oriented organizations, local media producers, local and regional governing bodies, and/or educators - to showcase Swan Valley's iconic plant, tell a success story for ESA, bring awareness, and - foster stewardship.

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[9] MNPS: https://mtnativeplants.org/

[10] SVC: Swan Valley Connections: https://www.swanvalleyconnections.org/

[11] MCC: https://www.mtcorps.org/

[12] MMYC Program: https://www.nationalforests.org/regional-programs/northern-rockies/mission-mountains-youth-crew-program

Policy and Regulation

Conservation Goal

Improve conservation of Water Howellia through public participation and implementation of existing policies and regulations in cooperation with federal, state, and Tribal land managers, private landowners, and other interested stakeholders.

Conservation Objectives

1) Re-establish an interagency technical working group, to include the USFS, USFWS, and the MTNHP (USFS 1997). This technical working group should periodically review the status of the species and assess the effectiveness of the 1997 Conservation Strategy for *Howellia aquatilis*, particularly during the post-delisting monitoring period from 2022 to 2036 (USFWS 2020).

2) Through collaboration between the USFS and USFWS and/or with an interagency technical working, ensure that the Post-Delisting Monitoring Plan (USFWS 2020) is implemented as scheduled and that results are analyzed - to determine a final post-delisting monitoring outcome.

3) Support the Flathead National Forest in its decision to incorporate the 1997 Conservation Strategy for *Howellia aquatilis* into the Flathead National Forest Revised Forest Plan[9] (FNF 2018).

4) Continue compliance with Water Howellia conservation measures through the Flathead National Forest Revised Forest Plan (FNF 2018).

REFERENCES

Lesica, P. 1990. Habitat requirements, germination behavior and seed bank dynamics of *Howellia aquatilis* in the Swan Valley, Montana. Unpublished report to the Flathead National Forest. Conservation Biology Research, Helena, MT. 44 pp. plus appendix.

Master, L., D. Faber-Langendoen, R. Bittman, G. Hammerson, B. Heidel, L. Ramsay, K. Snow, A. Teucher, and A. Tomaino. 2012. NatureServe Conservation Status Assessments: *Factors for Evaluating Species and Ecosystem Risk*. NatureServe, Arlington, VA.

Merigliano, Micheal F., and Peter Lesica. 1998. “The native status of reed canarygrass (*Phalaris arundinacea* L.) in the inland Northwest, U.S.A.” *Natural Areas Journal*, 18(3): 223-30.

Mincemoyer, Scott. 2005. Range-wide status assessment of *Howellia aquatilis* (water howellia). Prepared for the USFWS. Helena, MT: Montana Natural Heritage Program . 21 pp. + appendices.

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[9] Flathead National Forest Revised Forest Plan: https://www.fs.usda.gov/detailfull/flathead/home/?cid=stelprdb5422786&width=full

Montana Natural Heritage Program (MTNHP). 2016. Botany database compilation and analysis for Water Howellia in Montana. Information from 2015 to 2016 provided in datasheet, tabular, graphical, and summarized formats. Andrea Pipp, Program Botanist, MTNHP, Helena, MT.

Montana Natural Heritage Program (MTNHP). 2024a. *Howellia aquatilis* profile in the *Montana Field Guide*. https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PDCAM0A010 [Accessed 8 February 2024]

Montana Natural Heritage Program (MTNHP). 2024b. *Howellia aquatilis* observation data from the botany database. [Accessed 8 February 2024]

Montana Natural Heritage Program (MTNHP). 2022c. Implementing the Post-Delisting Monitoring Plan in Montana. Annual progress report. Submitted - to the USFWS, Denver CO, .by Program Botanist, MTNHP, Helena, MT.

Pipp, Andrea. 2017. An analysis of disturbance in buffers surrounding occupied Water Howellia (*Howellia aquatilis*) ponds and unoccupied ponds in Montana. Prepared for the USFWS, Montana Ecological Services Field Office, Helena, MT. Helena, MT: Montana Natural Heritage Program.19pp + appendix.

US Fish and Wildlife Service (USFWS). 1994. Endangered and Threatened wildlife and plants; the plant, Water howellia (*Howellia aquatilis*), determined to be a Threatened species. 50 CFR Part 17. Federal Register 59(134):35860-35864.

US Fish and Wildlife Service (USFWS). 1996. Technical Draft *Howellia aquatilis* Recovery Plan. Prepared by Steve Shelly, US Forest Service and Montana Natural Heritage Program, Missoula, MT and John Gamon, Washington Natural Heritage Program, Olympia, WA. Prepared for USFWS, Helena, Montana.

US Fish and Wildlife Service (USFWS). 1998. Proceedings from the Forum on Research and Management of *Howellia aquatilis*. March 24-25. Turnbull National Wildlife Refuge, Cheney, WA.

US Fish and Wildlife Service (USFWS). 2013. *Five-Year Review: Summary and Evaluation of Water Howellia*. Montana Ecological Services Field Office, Helena, MT.

US Fish and Wildlife Service (USFWS). 2020. Post-Delisting Monitoring Plan for Water Howellia (*Howellia aquatilis*). Prepared by USFWS, Montana Ecological Services Field Office, Helena, MT.

US Fish and Wildlife Service (USFWS). 2021. Endangered and threatened wildlife and plants; removing the water howellia from the list of endangered and threatened plants. Federal Register 86(114):31955-31972.

US Forest Service (USFS). 1997. Conservation Strategy - *Howellia aquatilis*. Second Edition, April. United States Department of Agriculture, Forest Service Northern Region, Kalispell, MT. 24 pp.

US Forest Service (USFS). 2018. Flathead National Forest Land Management Plan. Flathead, Lake, Lewis and Clark, Lincoln, Missoula, and Powell Counties, MT. Flathead National Forest, Kalispell, MT. https://www.fs.usda.gov/detailfull/flathead/home/?cid=stelprdb5422786&width=full

CONSERVATION PROFILE:
WHITEBARK PINE (*PINUS ALBICAULIS*)

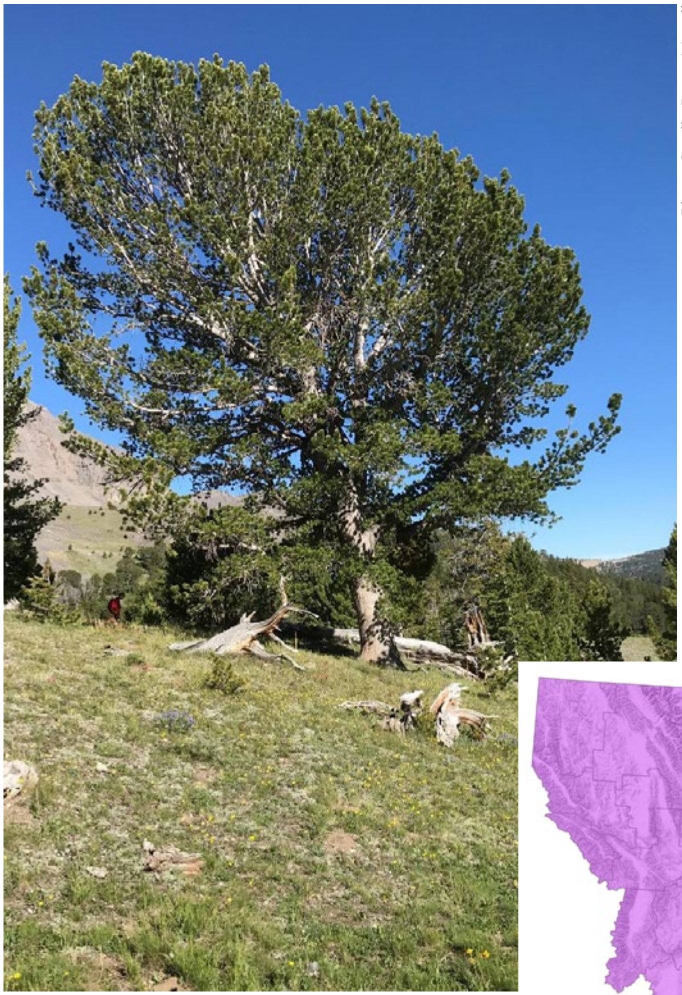
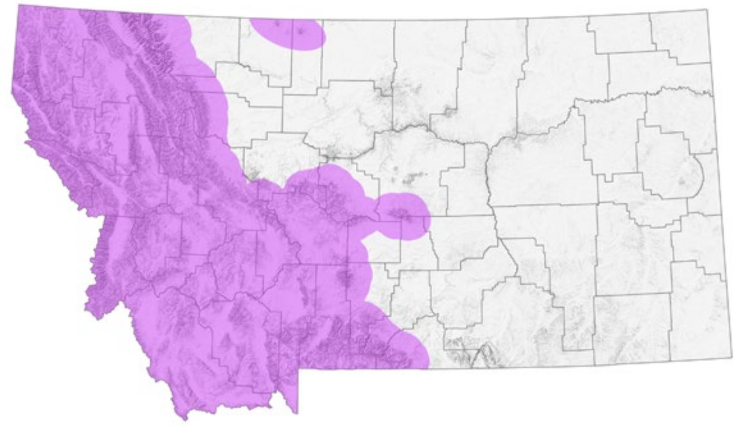


Photo Credit: Bryce Maxell

Photo 1. *A mature, healthy Whitebark Pine tree growing in the upper subalpine zone in Montana.*



Source: Montana Natural Heritage Program (2024a)

Figure 1. The range for Whitebark Pine in Montana.

PURPOSE:

*This conservation profile provides information about Whitebark Pine (*Pinus albicaulis*), a Plant Species of Greatest Conservation Need (GCN) in Montana, and the US Fish and Wildlife Services' recovery planning effort. It highlights the plant's state-level distribution, factors that put it at risk for loss, and conservation objectives that, if implemented, would aid its persistence. This conservation profile aims to be an abbreviated, stand-alone document that can be used by, or shared with, land managers, landowners, educators, decision-makers, regulators, and anyone interested in Whitebark Pine. This conservation profile should also be used in conjunction with Section 4 of the Montana Native Plant Conservation Strategy, which addresses overarching conservation objectives for Plant Species of GCN and in conjunction with the soon-to-be-released Whitebark Pine Recovery Plan.*

INFORMATION ON WHITEBARK PINE

Distribution, Status, and Identification

Whitebark Pine (*Pinus albicaulis*) is a prominent tree in the high-elevation forests of the western United States (US) and Canada (Photo 1) (Kral in Flora of North America 1993). Worldwide, the distribution of Whitebark Pine occurs from about 36 degrees North latitude in the southern Sierra Nevada Range to about 55 degrees North latitude in the northern coastal ranges of Canada (Tomback and Sprague 2022; McCaughey and Schmidt 2001). This area encompasses the US states of California, Idaho, Montana, Nevada, Oregon, Washington, and Wyoming, and the Canadian provinces of Alberta and British Columbia. In the Rocky Mountains, trees grow from about 42 degrees North latitude in the southern Greater Yellowstone area to about 54 degrees North latitude in Canada (Tomback and Sprague 2022; McCaughey and Schmidt 2001).

In Montana, Whitebark Pine trees are found in the major mountain ranges (Figure 1) (MTNHP 2024). They are a dominant or co-dominant tree in the upper subalpine zone where they often define the tree line, but also can be found growing at lower elevations (Figure 2). In the upper elevation communities, Whitebark Pine is considered a "climax" tree and will persist and maintain dominance due to optimal site conditions where it maintains a competitive foothold. Since it is averse to shade, trees grow most successfully on sites with full exposure to solar radiation and where tree canopies are open. However, Whitebark Pine can also be a "seral" species in lower subalpine and mid- to upper montane forests, particularly where there are sufficient gaps in the forest canopy (Figure 2).

Whitebark Pine has also established successfully in shrubland and lower montane vegetation types in Montana. In the southwest portion of the state, a Whitebark Pine population has established in the Mountain Big Sagebrush (*Artemisia tridentata*) community type (Guiberson 2020). In the southern Bitterroot Mountains (Arno 1993) and east of the Continental Divide (Pfister et al. 1977), trees have been known to occur in lower montane sites in Montana.

Across its distribution, both globally and in Montana, Whitebark Pine is predominantly found on federal lands (MTNHP 2024a; Tomback et al. 2022). The US Forest Service (USFS) is the largest landowner nationally and in Montana, with about 74% and 85% of Whitebark Pine's land area, respectively (MTNHP 2024a; Tomback et al. 2022). The National Park Service (NPS) is the second largest landowner nationally and in Montana, with about 10% and 7% of the land area, respectively (MTNHP 2024a; Tomback et al. 2022). The Bureau of Land Management (BLM) is the third largest landowner nationally with about 4% of the land base (Tomback et

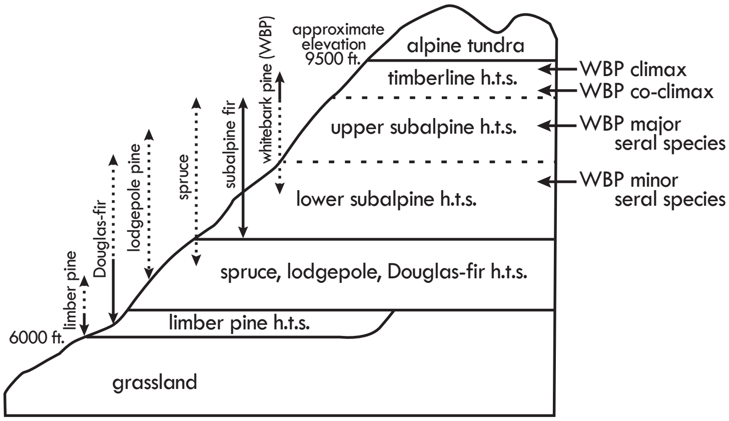


Figure 2. The general elevational distribution for forest trees and habitat type series (h.t.s.), including Whitebark Pine, on non-calcareous geological substrates in south-central Montana. Solid portion of arrow indicates where a species is the potential climax and the dotted portion shows where it is seral (Tomback, Arno, and Keane 2001).

al. 2022). In Montana, the Montana/Dakotas BLM (MT/Dakotas BLM) and the state are tied, each managing about 1% of the land area for Whitebark Pine (MTNHP 2024a). The remaining roughly 5% of land area for Whitebark Pine in Montana is under Tribal and private ownerships (MTNHP 2024a). Ski areas make up a large percentage of the privately owned land.

Learn about Whitebark Pine identification, biology, and state status in the Montana Field Guide[2]

Learn about Whitebark Pine range-wide information, federal status, and management in the USFWS Environmental Conservation Online Systems (ECOS)[3]

Learn about Whitebark Pine ecology, conservation, restoration, and educational efforts at the Whitebark Pine Ecosystem Foundation (WPEF)[4]

Whitebark Pine is a Montana Species of Concern (SOC) plant as determined by the Montana Natural Heritage Program (MTNHP) (2024b) (Photo 2). Ranked in the state as an S3, Whitebark Pine is vulnerable due to recent and widespread declines and threats (MTNHP 2024b). On January 17, 2023, Whitebark Pine was federally-listed as a threatened species under the Endangered Species Act (ESA) of 1973, as amend (87 FR 76882) (USFWS 2022a). A Recovery Outline[1] was issued in December 2022 (USFWS 2022b). A recovery plan is expected in 2024.

Roles as a Keystone and Foundation Species

Whitebark Pine is ecologically and culturally an important tree species throughout its range (Tomback et al. 2022). As a keystone species, the tree promotes biodiversity because its large, nutritious seeds provide wildlife food while mature stands create high-elevation nesting and foraging habitat for numerous birds and mammals (Tomback 1978; Hutchins and Lanner 1982; Arno 1986; Tomback and Kendall 2001; Cross and Crabtree 2021). The tree depends on the Clark's Nutcracker (*Nucifraga columbiana*), a bird that has shaped many features of the pine (Tomback 1982; WPEF 2024a). Cones mostly grow horizontally at the tips of vertical branches where they are easily accessible to birds. If not foraged upon by the Clark's Nutcracker, the cones remain on the branches to disintegrate at maturity – a unique feature for North American pines (Arno and Hammerly 1977). Their large seeds are wingless and cannot be carried by the wind. However, the Clark's Nutcracker hammers a hole into the thick cone scale with its long, pointed, and sturdy bill to extract the seed (Arno and Hammerly 1977) (Photo 2). They deposit the

*Photo 2. A Clark's Nutcracker (*Nucifraga columbiana*) has a long, pointed, and sturdy bill for hammering into pine cones.*

Photo Credit: Nathan DeBoer

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[1] Recovery Outline for Whitebark Pine: https://ecos.fws.gov/docs/recovery_plan/20221215_WBP_Final_Recovery_Outline_v11_DRDsigned.pdf NOTE: This reference will no longer be accessible once the recovery plan is issued.

[2] Montana Field Guide, Whitebark Pine: https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PGPIN04010

[3] USFWS ECOS website: https://www.fws.gov/species/whitebark-pine-pinus-albicaulis

[4] Whitebark Pine Ecosystem Foundation: https://whitebarkfound.org/our-work/national-whitebark-pine-restoration-plan/

seeds into their throat pouch – a structure unique to nutcrackers – and later bury them in the ground (seed cache). Seed caches become the primary food source for the adult birds, and their nestlings and fledglings. What doesn't get eaten germinates (Photo 3). Hence,

Photo Credit: Dee Blank

Photo 3. A cache of Whitebark Pine seeds – germinating.

Clark's Nutcrackers are an important long-distance disperser for Whitebark Pine seeds. The Red Squirrel (*Tamiasciurus hudsonicus*) is also quite adept at harvesting the cones, ripping the scales to expose the seeds, and storing cones in rotten logs and in the ground (Arno and Hammerly 1977). Seeds are also sought out by Grizzly and Black Bears (Ursus arctos and U. americanus, respectively) in Montana and Wyoming (WPEF 2024). For many Native American tribes, Whitebark Pine seeds are a traditional food (Lanner 1996; Moermon 1998).

Whitebark Pine is also a foundation species because it modifies the environment in a way that benefits animals living in these high-elevation landscapes. Whitebark Pine trees form plant communities that help stabilize the harsh high-elevation environments by initiating tree islands and influencing the retention and re-distribution of snow (Farnes 1990; Tomback et al. 2016). They create stable shelter for the establishment and growth of numerous other plants, and regenerate soon after fire and other ground-level disturbing events (Tomback et al. 2016). Mature and reproducing stands form discreet communities, often dominated by herbaceous and dwarf shrub understories dependent on snow catchment, prolonged summer moisture, and cooler soil temperatures. Many associated dwarf shrubs in these mature communities provide important culturally significant and wildlife (Grizzly bear and other high elevation fauna) food sources.

For people, the communities created by Whitebark Pine contribute to enjoyment and opportunities for recreation (Tomback and Sprague 2022). These pines may seldom be seen from a car, but hikers and mountain climbers who frequent the high country may refer to them as a sort of "old friend" (Arno and Hammerly 1977). Large, multi-stemmed old-growth trees and gnarled, wind-sculpted forms contribute beauty to these high-elevation landscapes sought by recreationists (Tomback and Sprague 2022) (Photo 4). They create an ecosystem in which people ski, hike, backpack, and picnic, which in turn helps to bolster local economies and the outdoor recreation industry Tomback and Sprague 2022).

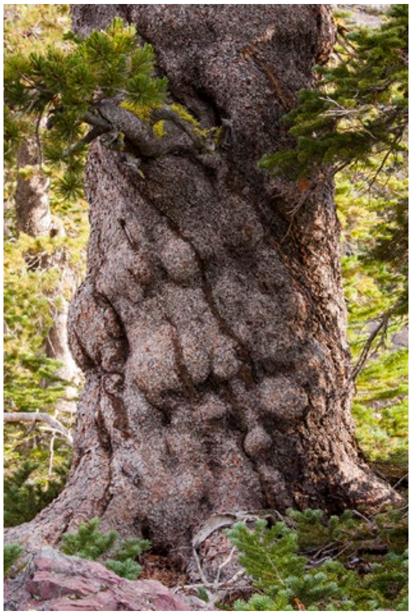
Photo Credit: Dee Blank

Photo 4. Whitebark Pine trees become sculptured by time and the environment.

RATIONALE FOR PLANT SPECIES OF GREATEST CONSERVATION NEED

Whitebark Pine is a Plant Species of Greatest Conservation Need (GCN) in Montana because of its ecological and cultural importance coupled with multiple, interrelated threats. Consequently, the loss of Whitebark Pine would lead to cascading ecosystem changes (Tomback and Kendall 2001).

Across its range, Whitebark Pine populations have drastically declined from a multitude of causes (Photos 5 and 6). High proportions of mature stands have been killed by *Cronartium ribicola*, an introduced pathogen that infects trees and causes White Pine Blister Rust (WPBR) disease, and by large-scale infestations of the native Mountain Pine Beetle, *Dendroctonus ponderosae* (USFWS 2018 and 2020; Tomback et al. 2022; Tomback and Sprague 2022). Data from the USFS's Forest Inventory Analysis (FIA) program estimates that, as of 2016, 51% of all standing Whitebark Pine trees in the US were dead (USFWS 2022a; Goeking et al. 2018). Further, the FIA data revealed that the number of dead trees with a diameter of five inches or greater increased dramatically between the 1990s and 2016 (Goeking and Islar 2018). Additionally, altered fire regimes and climate change are factors that likely drive population dynamics across its range (USFWS 2022a). Fire is an important landscape-level disturbance in these systems, but it might also be a stressor for Whitebark Pine. It's ability to withstand varying intensities of wildfire is not well understood. Changes in climate may contribute to an exacerbation of the primary threat factors, including susceptibility to infestation by forest pests, and changes in fire frequency and intensity (USFWS 2022). Research in Idaho suggests that a warm climate may increase growth of Whitebark Pine in certain locations (Kichas et al. 2020). However, much is still to be learned about how Whitebark Pine will respond to climate change.

Photo Credit: Melissa Jenkins

*Photo 5. A dead and dying Whitebark Pine stand succeeding to Subalpine Fir (*Abies lasiocarpa*) near Link Lake Trail on the Flathead National Forest.*

Photo Credit: Andrea Pipp

Photo 6. A young Whitebark Pine shows signs of an infection - green needles turning red. Beal Hill in Montana.

CONSERVATION GOALS & OBJECTIVES FOR WHITEBARK PINE

The intent of the *Montana Native Plant Conservation Strategy*: *Species and Habitats of GCN* is to promote the collective and coordinated stewardship of Montana's Plant Species of GCN to ensure their viability and persistence using a fusion of approaches. Sections 3-*Strengthening Botanical Capacity* and 4-*Plant Species of GCN* present overarching goals and conservation objectives that can indirectly help sustain Whitebark Pine populations. In this conservation profile we present conservation objectives specific to Montana's Whitebark Pine populations from four areas that are pillars of plant conservation:

- Information Needs [Inventory, Monitoring, Research]
- Protection and Restoration
- Outreach and Education
- Policy and Regulation

The conservation objectives were developed by a Whitebark Pine Working Group that met in December 2022 and January 2024, and are based on published research, monitoring, professional expertise, draft agency guidance, and field observations. **Due to Whitebark Pine's change in status to federally listed as threatened, these suggested conservation objectives for populations in Montana will continue to evolve – especially in anticipation of the recovery plan**. The working group consisted of biologists, ecologists, botanists, and foresters working for federal and state land management agencies (see Table 1 on page *iii* of the *Strategy*). Working within and across jurisdictional boundaries, these voluntary conservation objectives are intended to empower federal, state, Tribal, and non-government conservation land managers, landowners, businesses, and individuals who want to contribute to or collaborate on processes that could aid the persistence of Whitebark Pine. These voluntary actions can be pursued or implemented by a single entity, or as a collaborative effort by individuals, agencies, and organizations, including businesses. They are presented in no prioritized order.

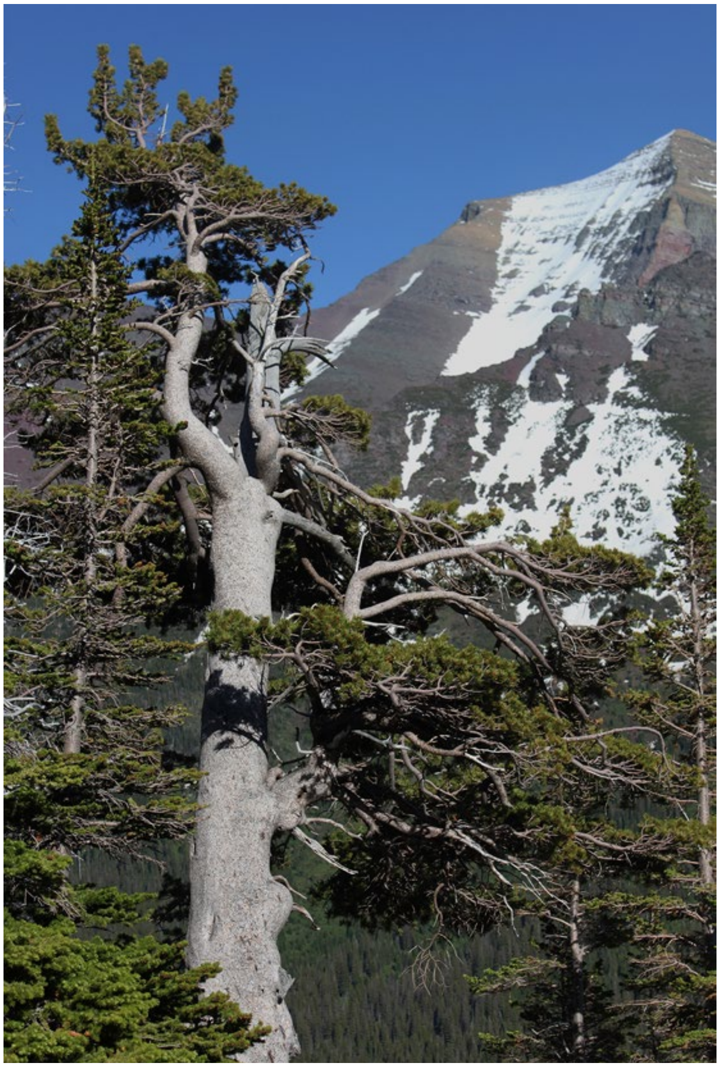

Photo Credit: Tara Luna

Photo 7. A Whitebark Pine tree in Glacier National Park.

This conservation profile in no way supersedes the operations or strategic directions for Whitebark Pine management and recovery on public, Tribal, and private lands. Federal and state land managers, along with other users of this conservation profile should first consult with the Recovery Plan, when released, for Whitebark Pine.

The USFS and Canadian genetic resource managers have developed a specialized set of terms that is used at tree nursery facilities that screen seed sources for blister rust (Tomback et al. 2022). The terms come from long-standing tree improvement and breeding programs that are now incorporating new genomic, forest management, and climate modelling approaches. Other practitioners in USFS-Region 1 have also developed terms and definitions (Hendrix 2024). A selection of terms and a brief definition is provided in this profile for convenience (Table 1). Users of this *Strategy* may want to consult the full suite of terms, definitions, and source references found in Tomback et al. 2022.

Table 1. Terms used by the United States Forest Service in Region 1 (Hendrix 2024; Tomback et al. 2022).

Term	Brief Definition
Genetic Resistance	The quantitative genetic resistance to Whitebark Pine Blister Rust. Resistance is based on polygenic inheritance of genes with allele frequencies that differ among individuals and populations meaning resistance spans a continuum.
Plus Tree	Relatively healthy, cone-bearing, phenotypically resistant trees that are included in a selective breeding program (geo-referenced and tagged tree) where performance is based on results of artificial inoculation screen trials and ranking for growth or from a stand with high infection level and mortality from White Pine Blister Rust (WBPR). The tree is a promising candidate for resistance screening, but resistance is not yet confirmed.
Elite Tree (resistant seed source)	A seed or plus tree confirmed through resistance screening to have heritable (genetic) resistance (i.e., reduced susceptibility) to WPBR. A plus tree with high ranking in blister rust resistance from the artificial inoculation screening trials and high ranking in growth trials.
Operational Collection Tree	A tree with characteristics that make it desirable as a source of cones to use in the production of seedlings for out-planting.
Phenotypically Resistant Tree	A tree that is relatively free of WPBR when compared to the infection level of the stand as a whole. Trees may or may not be part of the artificial inoculation screen trial.
Resistant Seedlings	Seedlings grown from elite tree seeds, or seeds from a mix of elite trees and unscreened plus trees. Since wind-pollinated seeds of elite parent trees will be used, there will be a wide continuum of susceptibility within seed lots, and seedling survival in high WPBR areas may be 50% or lower because of cross-pollination or recombination. Not all seedlings will carry resistance traits, but seedling survival is expected to be greater than for seedlings grown from untested plus trees alone. Bulked seed lots can be screened to provide a better estimate of the frequency of resistance for determining appropriate planting densities.

Information Needs [Inventory, Monitoring, Research]

Conservation Goal

Improve scientific understanding of Whitebark Pine in Montana and the ecological and cultural processes that sustain plants and populations through statewide coordination, inventory, monitoring, and research.

Conservation Objectives for Inventory

1) Work collaboratively with federal, state, Tribal, and private landowner partners to acquire necessary field data and biological information so the MTNHP can evaluate information to:
    a. Maintain an accurate and timely Subnational Rank (hereafter the State Rank or S-Rank) for Whitebark Pine in Montana.
    b. Determine the State Threat Score and rationale for Whitebark Pine in Montana. The State Threat Score represents the degree to which the target plant is degraded by extrinsic factors, which are characterized in terms of timing, severity, and scope (MTNHP 2021b; Master et al. 2012). As of 2024, Whitebark Pine in Montana lacks a State Threat Score. Once assigned, it is recommended that the State Threat Score and rationale be updated by MTNHP at five-year intervals, or as warranted by current data. It is also recommended that threat reports and data analysis be more transparent and posted on the Montana Field Guide species profile.
2) Promote genetic resistance to WPBR in Montana by identifying seed zones for Whitebark Pine or by improving designated seed zone boundaries as more genetic information and results from common garden and genomic studies become available (Tomback et al. 2022). Seeds collected from any tree within the designated seed zone will generally be adapted across that environment; therefore, identifying seed zones can reduce the loss of planted seedlings or trees from maladaptation. Analysis units identified in the Species Status Assessment (SSA) generally serve as seed zones (USFWS 2021).

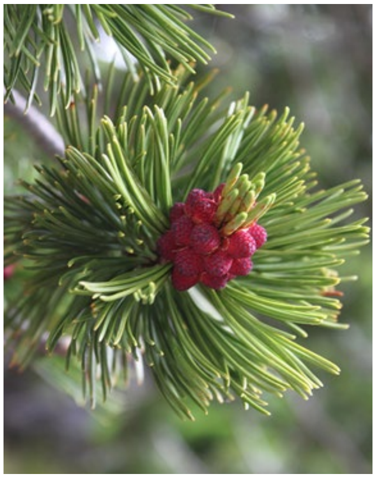

Photo Credit: Tara Luna

Photo 8. Whitebark Pine pollen (male) cones are typically reddish.

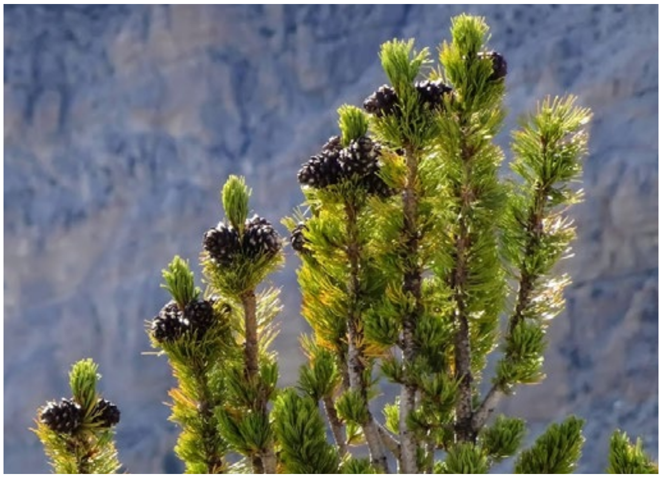

Photo Credit: Mike Chapman

Photo 9. Whitebark Pine seed cones (female) grow horizontally at the tips of branches.

Information Needs [Inventory, Monitoring, Research]

3) Support the process for obtaining genetic resistance to WPBR using defined methods to inventory and select seed and plus trees, conduct resistance screening, and obtain a target number of elite trees for restoration plantings in each seed zone. The number of trees to identify and select - to obtain the target number for restoration plantings will vary greatly depending upon the regional or local incidence of blister rust infections. The concept is that about 100 elite trees with usable resistance to blister rust are needed within a particular seed zone over time to maintain genetic resistance (Tomback 2022).

4) Within a geographic area, collect cones from plus and elite trees, especially in good years of production. This would involve using certified tree climbers to climb trees in early summer and install hardware cloth or screen envelopes around unripe cones. These envelopes protect the maturing cones from seed removal by squirrels and Clark's Nutcrackers. Certified tree climbers would return in late summer to fall to climb and harvest ripe cones.

5) Continue efforts that update and share spatial data layers of high-value Whitebark Pine tree and stand locations. These ongoing efforts help inform decisions related to wildland fire management, specifically to assist in decisions of implementing full suppression, partial suppression, or allowing to burn (Tomback et al. 2022).

Conservation Objectives for Monitoring

1) When conducting silvicultural or fire treatments intended to restore ecosystem processes or promote Whitebark Pine retention and growth, consider incorporating a long-term monitoring program designed to include (Tomback et al. 2022):
    - A narrowly focused and well-articulated management question(s) and/or objective(s),
    - A random sampling design that stratifies by elevation, aspect, access or safety considerations, or other criteria,
    - Input from a statistician to pre-determine the type of statistical analyses that should be done.

2) Support and participate in the monitoring network that was initiated and funded in 2023. Joining a monitoring network helps gather statewide data on the health status of Whitebark Pine stands to help with conservation, restoration, and other management actions and decisions. This network could incorporate - both one-time surveys and repeated monitoring plots where trees are geolocated and tagged to collect precise re-measurements.

Photo Provided by: Melissa Jenkins, USFS.

Photo 10. Volunteers from the Bob Marshall Wilderness Foundation conduct a 20-year remeasurement of Bob Keane's 1994 study plots. Refer to Retzlaff et al. 2016.

Information Needs [Inventory, Monitoring, Research]

3) Support and continue existing monitoring efforts and other long-term data collection efforts that involve Whitebark Pine. Existing monitoring efforts and networks can help track tree health conditions, forest composition and structure, and many other elements. Valuable existing long-term data collection efforts include, but are not limited to:

   - USFS-FIA[5]. The FIA program collects broadscale vegetation data across the US, using a grid-based, coarse level inventory that is re-measured on a ten-year interval. The FIA program can support localized needs for information by installing off-grid plots at a higher density.
   - USFS stand exam data collected by each National Forest.
   - Interagency Whitebark Pine Monitoring Program in the Greater Yellowstone Ecosystem[6].

4) Continue collaboration among USFS-Region 1, MT/Dakotas BLM, and NPS geneticists in promoting genetic resistance and supporting the establishment and use of seed orchards. Whitebark Pine seed orchards that contain 30 to 60 unrelated elite trees from the same seed zone could improve access to a seed source that is more likely to have resistance to White Pine Blister Rust (Tomback et al. 2022). Seed orchards also allow controlled pollination, which can improve progeny resistance.

Photo Credit: Scott Palmer

Photo 11. Cones growing on a graft in the Lolo NF seed orchard. Cone bearing scion material from the top third of the tree continues to produce cones when grafted onto rootstock.

5) Promote genetic resistance by extending existing federal collaboration to other partners, as warranted. Potential partnering organizations include, but are not limited to:

   - Montana Department of Natural Resources and Conservation (MTDNRC), including Montana Native Seed Network (MTNSN) (See also Section 3, Information Needs, Conservation Objective #6).
   - Other State of Montana land management agencies, such as Montana Department of Environmental Quality (MTDEQ), Montana Department of Transportation (MDT), and Montana Fish, Wildlife & Parks (MFWP).
   - Tribal Nations, such as the Confederated Salish & Kootenai Tribes (CSKT) of the Flathead Reservation and Blackfeet Nation of the Blackfeet Reservation.
   - Montana State University (MSU) - Department of Plant Sciences and Plant Pathology or a Professor of Mycology.
   - University of Montana (UM) - Department of Ecosystem and Conservation Sciences or School of Forestry.
   - USFS, Rocky Mountain Research Station, Fort Collins, Colorado[7].

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[5] Forest Inventory Analysis: https://research.fs.usda.gov/programs/fia

[6] 2017 Annual Monitoring Report: https://irma.nps.gov/DataStore/DownloadFile/604180

[7] Rocky Mountain Research Station: https://www.fs.usda.gov/rmrs/

Information Needs [Inventory, Monitoring, Research]

6) Promote studies that examine the role of genetics in susceptibility and resistance of Whitebark Pine to Mountain Pine Beetle attack. Monitoring data that re-assesses areas of past treatments could be incredibly helpful in informing release rates, attack densities, and tree loss from biotic agents. There is a need for surveys that inform our understanding of severity and extent of mountain pine beetle outbreaks, as well as information on post-outbreak survival and regeneration.

7) Support ongoing efforts to promote genetic resistance to White Pine Blister Rust using various screening protocols that involve garden-, greenhouse-, and/or field-based studies:

    - *Garden / Greenhouse Studies:* Current management practices for restoration of Whitebark Pine suggest finding trees with usable resistance to White Pine Blister Rust for each seed zone. Screening involves seedlings grown from seed or plus trees, exposed to high spore densities of *Cronartium ribicola*, and evaluated through time for symptoms of infection, signs of resistance, and, if applicable, specific resistance phenotypes (Tomback et al. 2022).
    - *Field Trial Studies*: Continue field trials in which seedlings from seed or plus trees are out-planted in forested areas with a known White Pine Blister Rust hazard and continue monitoring them for resistance and susceptibility under natural infection conditions. Field trials evaluate the effectiveness of the seedling screening trials, which take place under artificial conditions, in addition to testing the durability and stability of the resistance (Tomback et al. 2022).

8) For an established component population, conduct genetic monitoring to detect declines in genetic diversity as newly planted trees mature (Jenkins et al. 2022).

9) For existing mature populations, conduct genetic monitoring to determine the level of gene flow between populations.

Conservation Objectives for Research

1) Design and conduct studies that examine the relationship between resistance to Mountain Pine Beetle and to White Pine Blister Rust for Whitebark Pine trees and seedlings (Tomback et al. 2022). Research questions identified by Tomback et al. 2022 include:

    - Are certain Whitebark Pine phenotypes more resistant to Mountain Pine Beetle infestations?
    - How does selecting for resistance to White Pine Blister Rust affect the tree's resistance to Mountain Pine Beetle?
    - How does selection for certain resistant phenotypes affect the tree's ability to adapt to changing environments and other pests and pathogens?

2) Design studies to gain information on how much gene flow occurs between populations of Whitebark Pine (Jenkins et al. 2022). The distance of 7.5 miles was determined to be a critical distance that would ensure gene flow between Whitebark Pine populations and was calculated based on flight distances of Clark's Nutcrackers and the potential for long-distance pollen travel (Jenkins et al. 2022). Refer to Jenkins et al. 2022 for suggested research needs.

3) When considering research needs for Whitebark Pine, consult with foresters, botanists, and biologists working for Montana-based land management agencies, especially MT/Dakotas BLM, USFS-Region 1, GNP, YNP, and MTDNRC.

4) Conduct research to improve genetic testing and methods to distinguish Whitebark Pine and Limber Pine trees.

5) Investigate ways to increase overall genetic diversity of Whitebark Pine to promote resistance to Mountain Pine Beetle and other damaging agents.

Protection and Restoration

Conservation Goal

Secure on-the-ground, site-specific habitat and/or management protection or restoration for Whitebark Pine on public and private lands

Conservation Objectives for Protection

1) Land management agencies and private landowners should strive to or continue their efforts to protect seed sources of plus trees, elite trees, and seed orchards from Mountain Pine Beetle, such as with the anti-aggregation pheromone verbenone or by thoroughly spraying trees with carbaryl or pyrethroids (e.g., bifenthrin or permethrin) insecticides. This level of coordination is already in place for some land management agencies in Montana.

2) The locations of plus trees, elite trees, and seed orchards should be incorporated into the land management agency's fire management plan and timber management plan. This level of coordination is already in place for some land management agencies in Montana.

3) Retain all healthy Whitebark Pines trees. If unavoidable, select for shorter trees and those growing in groups with other trees - to prevent losing trees to high winds (Murray et al. 2022).

4) Implement proactive intervention approaches in forest communities where *Cronartium rupicola* is at low levels or absent. This approach uses silvicultural treatments to prepare the landscape to boost Whitebark Pine resiliency to anticipated future or increased levels of infection. NOTE: Readers should refer to Table 4 on page 12 in the paper by Tomback et al. 2022.

Photo Credit: Andrea Pipp

Photo 12. A stand of dead mature Whitebark Pine trees – likely from Mountain Pine Beetle - on Beal Hill in Montana.

Protection and Restoration

Conservation Objectives for Restoration

1) When published, support the recovery actions and activities included in the recovery plan for Whitebark Pine. Support federal and state land management agencies in implementing relevant restoration actions identified in the forthcoming recovery plan.

2) For land management agencies with jurisdiction within the range of Whitebark Pine, consider developing a plan to identify and prioritize restoration activities. One method to consider is the six-step methodology developed for the Crown of the Continent Ecosystem (Jenkins et al. 2022)[8]. This GIS-based method was applied to a subset of the Crown of the Continent Ecosystem, namely Glacier National Park, Flathead National Forest, and Flathead Indian Reservation. The method creates a restoration plan with site-specific actions designed to protect and restore genetically diverse and potentially stable populations that may exhibit on-going evolutionary adaptation across the area of interest. The method can be adapted for use anywhere within Whitebark Pine's range, as well as to populations of other high elevation five-needle pines, such as Limber Pine (*Pinus flexilis*).

3) Future climate scenarios must be considered in conjunction with all restoration objectives and projects (adaptive management). Examples include determining the location and timing to apply tree thinning or prescribed fire treatments, thinning competing species to increase the vigor of surviving trees, and using appropriate genotypes to sow seed or plant Whitebark Pine seedlings.

4) Continue to conserve genetic diversity through seed collection[9], accession storage, and testing. Continue to employ seed collecting protocols that aim to preserve genetic diversity across different seed zones, geographical areas, and elevational bands. Collectors and researchers need to continue to search for seed producing stands that exhibit disease and pest resistance. During the immediate future, and as younger trees reach reproductive status, collectors should target those populations that have shown resilience to recent frequent and intensifying periods of drought, coupled with warming temperatures at higher elevations. These stands may exhibit important recent genetic adaptive traits to contemporary climate change during the past 30 years.

Photo Credit: Aram Eramian

Photo 13. Burlap bags full of cones are placed on drying racks until ready to put into the seed extractor at the Coeur d'Alene Nursery in Idaho.

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[8] Crown of the Continent Ecosystem (CCE) strategy: https://www.fs.usda.gov/research/treesearch/62150

[9] Seed collections from different geographical areas can be used to determine genetic diversity within and among populations, for assigning seed zones, - for determining adaptive traits such as cold hardiness and drought tolerance, and for assessing regional differences in genetic resistance to White Pine Blister Rust.

Protection and Restoration

5) Prescribed fires can serve as a restoration tool for Whitebark Pine, but one that is very dependent on specific stand conditions and size classes. Any prescribed fire should be carefully planned and implemented to reduce the risk of killing mature Whitebark Pine trees.

6) When conducting restoration activities, apply best management practices to avoid removing or damaging healthy, unsuppressed Whitebark Pine trees.

Photo Credit: Robert Keane

Photo 14. A fire specialist working for the US Forest Service ignites a controlled burn to restore Whitebark Pine habitat in Idaho.

Outreach and Education

Conservation Goal

Facilitate the stewardship of Whitebark Pine and communities through education, outreach, and coordination.

Conservation Objectives

1) Support the scientific and educational efforts of the Whitebark Pine Ecosystem Foundation[10]. Consider getting involved and/or becoming a member.

2) Revise the Whitebark Pine profile in the Montana Field Guide to current MTNHP standards to update and expand known information on life history, ecology, fire ecology, population counts and trends, genetics, germination, transplant experiments, pollination biology, identification, biological characteristics, economics, rangeland management, threats, taxonomy, and other interesting facts; create links to the Strategy and other online information; and improve its readability.

3) Through collaboration with federal and state agencies, develop a centralized web page or website where information on Whitebark Pine relative to Montana can be publicly shared and updated by pertinent agency staff. A central platform that provides published literature, shares agency resources, and gives other information would facilitate management across administrative boundaries, improve coordination on surveys and monitoring efforts, and promote educational outreach.

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[10] Whitebark Pine Ecosystem Foundation: https://whitebarkfound.org

Outreach and Education

4) Garner public support for Whitebark Pine communities by developing educational materials geared to backcountry users, such as skiers, climbers, hikers, and campers. Educational materials that address Whitebark Pine ecology, cultural and ecological values, threats, and the need for protecting and/or restoring these trees creates an informed culture, builds a network of partners and collaborators, and can help conservation efforts (US Forest Service 2022; Tomback et al. 2022).

    a. Encourage any ski area in Montana that has Whitebark Pine to consider becoming a Certified Whitebark Pine Friendly Ski Area[11] (WPEF 2024b). The WPEF's certification process includes three categories of actions: Education, Conservation, and Management/Restoration/Research.

    b. For ski areas in Montana that are Certified Whitebark Pine Friendly Ski Areas, send them a note of appreciation and encourage them to re-certify when the certification period ends (WPEF 2024b). Find the list of certified Whitebark Pine Friendly Ski Areas on the Ski Area Certification webpage[11].

    c. Distribute the USFS-Region 1 informational brochure or series of brochures on Whitebark Pine.

5) Collaborate with the WPEF and/or other organizations to promote the education campaign of "Needles of five, keep it alive" by posting into local newspapers before Thanksgiving and Christmas. This campaign educates people on the value of five-needle pines, the threats they face, and the rationale for not using them as Christmas trees and boughs.

6) Work with educational organizations or programs to help citizen science data collection efforts, -develop educational materials, and/or provide educational outreach relative to Whitebark Pine. Potential organizations to collaborate with include, but are not limited to:
    - Adventure Scientists[12]
    - iNaturalist[13]
    - Montana WILD[14]
    - Montana Discovery Foundation[15]
    - Montana Native Plant Society[16]
    - Tribal nations

Photo Credit: Sue Crispin

Photo 15. Whitebark Pine in Montana.

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[11] WPEF Ski Area Certification: https://whitebarkfound.org/our-work/ski-area-certification/
[12] Adventure Scientists: https://www.adventurescientists.org/
[13] iNaturalist: https://www.inaturalist.org/
[14] Montana WILD: https://fwp.mt.gov/education/montana-wild
[15] Montana Discovery Foundation: http://www.montanadiscoveryfoundation.org/
[16] Montana Native Plant Society: https://mtnativeplants.org/

Outreach and Education

7) Educate the public, landowners, land managers, and land-use planners about the "keystone" and "foundational" roles that Whitebark Pine trees and community's exhibit. This helps garner public support and involvement in actions that improve the health and persistence pf these communities.

8) Extend invitations to members of Tribal Nations within the Montana range of Whitebark Pine to engage in conversations, listen to their knowledge, and hear their concerns and needs regarding Whitebark Pine.

9) Acknowledge Whitebark Pine as a cultural resource in Montana and respectfully consult Tribal leaders or Tribal Liaisons about how to incorporate traditional or Indigenous uses and management of Whitebark Pine - including their action to not convey.

Policy and Regulation

Conservation Goal

Improve conservation of Whitebark Pine through public participation and implementation of existing policies and regulations in cooperation with federal, state, and Tribal land managers, private landowners, and other interested stakeholders.

Conservation Objectives

1) Support the development of a recovery plan authored by the USFWS. Implement recovery objectives of the USFWS plan across all agencies and in conjunction with current and future research, restoration and conservation projects.

2) Support Whitebark Pine management as outlined by the Montana Forest Action Plan (2020) for Forest Health: "Develop a statewide inventory of forest conditions, pests and root diseases, and responses to natural and human disturbances that improves the ability to track and model forest healthy conditions over time. Target at-risk species specifically, such as limber and whitebark pines, that have potential for threatened and endangered listing."[17]

Photo Credit: Melissa Jenkins

Photo 16. A two-year-old containerized seedling is ready for planting.

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[17] Montana Forest Action Plan (2020), p. 37, Goal #1, Bullet 7

Policy and Regulation

3) Support Whitebark Pine management as outlined by the Montana Forest Action Plan (2020) for Forest Health: “Improve baseline data and risk information on old growth and species at risk, such as Whitebark Pine and Western White Pine, due to ecological importance of these species and the risk of loss due to climate change and uncharacteristic disturbance.”[18]

4) Support Whitebark Pine management on private and publicly owned forests as outlined by the Montana Forest Action Plan (2020) for Working Forests and Economies:

   - “Support conservation projects that provide multiple social, economic, and ecological benefits, including an ongoing supply of forest products, public access to recreation opportunities, watershed health, and wildlife habitat...Engage private landowners adjacent to federal and state lands to participate in cross-boundary projects as they are developed.”[19]
   - “Invest in innovative targeted marketing strategies and expand partnerships to increase stewardship activities on non-industrial private forest lands.”[20]
   - “Increase data sharing across jurisdictions, specifically pertaining to road inventories, right of way, and forest stand data to emphasize collaborative transportation planning, where appropriate.”[21]

5) Support Whitebark Pine management as outlined by the Montana Forest Action Plan (2020) for Biodiversity and Habitat Conservation through Goal #1: “Improve and maintain Montana’s wildlife and biodiversity, including maintaining and restoring connected habitats, through collaborative approaches.”[22]

6) Support Whitebark Pine management as outlined by the Montana Forest Action Plan (2020) for Biodiversity and Habitat Conservation through Goal #3: “Mitigate the impacts of climate change to wildlife and biodiversity.”[23]

7) Support Whitebark Pine management as outlined by the Montana Forest Action Plan (2020) for Human and Community Health through Goal #4: “Mitigate the impacts of climate change to the people of Montana.”[24]

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[18] Montana Forest Action Plan (2020), p. 38, Goal #4, Bullet 1

[19] Montana Forest Action Plan (2020), p. 52, Goal #1, Bullet 4, sub-bullet 2

[20] Montana Forest Action Plan (2020), p. 52, Goal #1, Bullet 6

[21] Montana Forest Action Plan (2020), p. 52, Goal #1, Bullet 9

[22] Montana Forest Action Plan (2020), p. 62, Goal #1, Bullets 1, 3, 6, 8, 11, 12, and 13

[23] Montana Forest Action Plan (2020), p. 63, Goal #3, Bullets 1, 2, and 3

[24] Montana Forest Action Plan (2020), p. 79, Goal #4, Bullets 1 and 3

REFERENCES

Arno, Stephen F., and Ramona P. Hammerly. 1977. *Northwest Trees*. Seattle, WA: The Mountaineers.

Arno, Stephen F. 1986. "Whitebark pine cone crops – a diminishing source of wildlife food?" *Western Journal of Applied Forestry* 1 (3): 92-4. https://doi.org/10.1093/wjaf/1.3.92

Arno, S. 1993. Personal Communication. From Steve Arno, USFS Forest and Fire Ecologist, Missoula, MT to Mary Manning, USFS Ecologist, Missoula, MT.

Cross, Patrick R., and Robert Crabtree. 2021. "Recent findings suggest adding red fox (*Vulpes vulpes*) to climate-threatened whitebark pine (*Pinus albicaulis*) trophic system." *Canadian Journal of Zoology* 99(7): 618-23.

Farnes, P. 1990.00 SNOTEL and snow course data: describing the hydrology of whitebark pine ecosystems. In: Schmidt, W., and K. McDonald (compilers), *Proceedings-Symposium on Whitebark Pine Ecosystems: Ecology and Management of a High-mountain Resource*. General Technical Report INT-270, USFS, Intermountain Research Station, Ogden, UT, pp. 302-304.

Federal Register. 2020. "Endangered and Threatened Wildlife and Plants; Threatened Species Status for *Pinus albicaulis* (Whitebark Pine) with Section 4(d) Rule." 85:232 (December 2, 2020). United States Fish and Wildlife Service (USFWS), Washington DC. 77408.

Federal Register. 2022. "Endangered and Threatened Wildlife and Plants; Threatened Species Status with Section 4(d) Rule for Whitebark Pine (Pinus albicaulis)." 87:240 (December 15, 2022). United States Fish and Wildlife Service (USFWS), Washington DC. 76882.

Goeking, Sara, Deborah Izlar and Thomas Edwards. 2018. "A landscape-level assessment of whitebark pine regeneration in the Rocky Mountains, USA." *Forest Science* 65(1): 87-99.

Guiberson, E. 2020. Personal Communication. From Emily Guiberson, MT/Dakotas BLM Field Office Silverculturalist, Dillon, MT to Mary Manning, USFS Ecologist, Missoula, MT.

Hendrix, Amanda. 2024. Personal Communication on USFS terminology. May 6th. From Amanda Hendrix, USFS Region 1 Botanist, Missoula, MT to Andrea Pipp, MTNHP Botanist, Helena, MT.

Hutchins, H.E., and R.M. Lanner. 1982. "The central role of Clark's Nutcracker in the dispersal and establishment of whitebark pine." *Oecologia* 55 (2): 192-201.

Jenkins, Melissa; Incashola Jr., Tony; LaFleur, Dawn; Hoang, Linh; Renwick, Katie; Schoettle, Anna; Mellman-Brown, Sabine; Lozeau, James; O'Bennick, Kelly Rose; Meyer, Elliott; Anderson, Karl; Sissons, Rob; Keane, Bob; Jones, Brad. 2020. Crown of the Continent Ecosystem Whitebark Pine Restoration Strategy: 2019 Pilot - Project Summary. Crown Managers Partnership (CMP), High Five Working Group (Hi5WG). 8 p. https://www.fs.usda.gov/research/treesearch/62150 [Accessed 4 June 2024]

Jenkins, Melissa, Anna Schoettle, Jessica Wright, Karl Anderson, Joseph Fortier, Linh Hoang, Tony Incashola Jr., Robert Keane, Jodie Krakowski, Dawn LaFleur, Sabine Mellmann-Brown, Elliott Meyer, ShiNaasha Pete, Katherine Renwick, and Robert Sissons. 2022. "Restoring a forest keystone species: A plan for the restoration of Whitebark Pine (*Pinus albicaulis* Engelm.) in the Crown of the Continent Ecosystem." *Forest Ecology and Management*. 522: 120282.

Keane, Robert. 2001. "Successional dynamics: modeling an anthropogenic threat." In: Whitebark Pine Communities: Ecology and Restoration. Diana F. Tomback, Stephen F. Arno, Robert E. Keane, (eds). Washington, DC: Island Press.

Keane, Robert, and Russell Parsons. 2010. *Management guide to ecosystem restoration treatments: Whitebark pine forests of the northern Rocky Mountains*, U.S.A. Gen. Tech. Rep. RMRS-GTR-232. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 133 p.

Keane, Robert, and Diana Tomback; Carol Aubry, Andrew Bower, Elizabeth Campbell, Cathy Cripps, Melissa Jenkins, Mary Mahalovich, Mary Manning, Shawn McKinney, Michael Murray, Dana Perkins, Dan Reinhart, Chris Ryan, Anna Schoettle, and Cyndi Smith. 2012. *A range-wide restoration strategy for whitebark pine* (Pinus albicaulis). Gen. Tech. Rep. RMRS-GTR-279. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 108 p.

Kichas, Nickolas E., Sharon M. Hood, Gregory T. Pederson, Richard G. Everett and David B. McWethy. 2020. "Whitebark pine (*Pinus albicaulis*) growth and defense in response to mountain pine beetle outbreaks." *Forest Ecology and Management* 457:1-13.

Kral, Robert. 1993. *Flora of North America North of Mexico, Pteridophytes and Gymnosperms. Volume 2*. New York: Oxford University- Press. 475 pp.

Lanner, R. 1996. *Made for Each Other: A Symbiosis of Birds and Pines*. New York: Oxford University Press.

Lorenz, T., C. Aubry, C. and R. Shoal. 2008. A review of the literature on seed fate in whitebark pine and the life history traits of Clark's nutcracker and pine squirrels. General Technical Report PNW-GTR-742, USDA Forest Service, Pacific Northwest Research Station, Portland, OR-.

Master, L., D. Faber-Langendoen, R. Bittman, G. Hammerson, B. Heidel, L. Ramsay, K. Snow, A. Teucher, and A. Tomaino. 2012. *NatureServe Conservation Status Assessments: Factors for Evaluating Species and Ecosystem Risk*. NatureServe, Arlington, VA.

McCaughey, W., and W. Schmidt. 2001. "Taxonomy, distribution, and history." In: *Whitebark Pine Communities: Ecology and Restoration*. Diana F. Tomback, Stephen F. Arno, and Robert Keane, (eds.). Washington, DC: Island Press. pp 29-40.

McKinney, S., C. Fiedler, and D. Tomback. 2010. Altered species interactions and implications for natural regeneration in Whitebark Pine communities. Pages 56-63. In: Keane, Robert E.; Tomback, Diana F.; Murray, Michael P.; Smith, Cyndi M., (eds). 2011. The future of high-elevation, five-needle white pines in Western North America: Proceedings of the High Five Symposium; 28-30 June 2010; Missoula, MT. Proceedings RMRS-P-63, USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO-.

Moerman, D., 1998. *Native American Ethnobotany*. Portland, OR: Timber Press.

Montana Forest Action Advisory Council. 2020. Montana Forest Action Plan. December. Convened by the Montana Department of Natural Resources and Conservation, Helena, MT. https://www.montanaforestactionplan.org/pages/forest-action-plan

Montana Natural Heritage Program (MTNHP). 2024a. An assessment of modelled land area for *Pinus albicaulis*. MTNHP database. June. Helena, MT.

Montana Natural Heritage Program (MTNHP). 2024b. A query of *Pinus albicaulis* data. MTNHP botany database. January to June. Helena, MT.

Murray, M.P., Moody, R., in press. Blister rust infection trends and distribution in southern British Columbia's endangered whitebark pine. In: Strong, W. (Ed.) Joint conference: Genetics of Five-needle Pines and Rusts of Forest Trees, IUFRO. British Columbia Ministry of Lands and Natural Resource Operations, BC, Canada.

Negron, Jose F., and Laurie Huckaby. 2020. "Reconstructing historical outbreaks of mountain pine beetle in lodgepole pine forests in the Colorado Front Range." *Forest Ecology and Management* 473: 118270

Pfister, R., and B. Kovalchik, S. Arno, and R. Presby. 1977. Forest habitat types of Montana. General Technical Report INT-34, USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT.

Retzlaff, Molly L., Leirfallom, Signe B., and Keane, Robert E. 2016. A 20-year reassessment of the health and status of Whitebark Pine forests in the Bob Marshall Wilderness Complex, Montana. Res. Note RMRS-RN-73. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 10 p.

Schwandt, J.W. 2006. Whitebark pine in peril: A case for restoration. USDA Forest Service, Forest Health Protection, R1-06-28. 20pp.

Tomback, Diana. 1978. "Foraging strategies of Clark's Nutcracker." *Living Bird* 16: 123-61.

Tomback, Diana. 1982. "Dispersal of whitebark pine seeds by Clark's Nutcracker: a mutualism hypothesis." *Journal of Animal Ecology* 51(2): 451-67.

Tomback, Diana. 2022. Personal Communication. October to December. Department of Integrative Biology, University of Colorado, Denver, CO.

Tomback, Diana, Stephen Arno, and Robert Keane (eds.). 2001. *Whitebark Pine communities: ecology and restoration*. Washington, DC: Island Press DC.

Tomback, Diana. and Kate Kendall. 2001. "Biodiversity losses: the downward spiral." In: Tomback, Diane, Stephen Arno, and Robert Keane (eds.), *Whitebark Pine communities: ecology and restoration*. Washington, DC: Island Press, pp 243-262.

Tomback, Diana, Lynn Resler, Robert Keane, Elizabeth Pansing, Andrew Andrade, and Aaron Wagner. 2016. "Community structure, biodiversity, and ecosystem services in treeline Whitebark Pine communities: potential impacts from a non-native pathogen." *Forests* 7(1): 21. https://doi.org/10.3390/f7010021

Tomback, Diana and Eric Sprague. 2022. The National Whitebark Pine Restoration Plan: Restoration model for the high elevation five-needle white pines. *Forest Ecology and Management* 521: 120204.

Tomback, Diana, Robert Keane, Anna Schoettle, Richard Sniezko, Melissa Jenkins, Cara Nelson, Andrew Bower, Clay Demastus, Emily Guiberson, Jodie Krakowski, Michael Murray, Elizabeth Pansing, and Julee Shamhart. 2022. Tamm Review: Current and recommended management practices for the restoration of whitebark pine (*Pinus albicaulis* Englm.), an imperiled high-elevation Western North American forest tree. *Forest Ecology and Management* 522: 119929.

Whitebark Pine Ecosystem Foundation (WPEF). 2022. https://whitebarkfound.org [Accessed November 2023]

Whitebark Pine Ecosystem Foundation (WPEF). 2024a. Wildlife and Whitebark Pine. https://whitebarkfound.org/wildlife/ [Accessed June 2024]

Whitebark Pine Ecosystem Foundation (WPEF). 2024b. Ski Area Certification. https://whitebarkfound.org/our-work/ski-area-certification/ [Accessed January 2024]

United States Fish and Wildlife Service (USFWS). 2021. Species Status Assessment Report for Whitebark Pine, *Pinus albicaulis* v. 1.3. Wyoming Ecological Service Field Office.

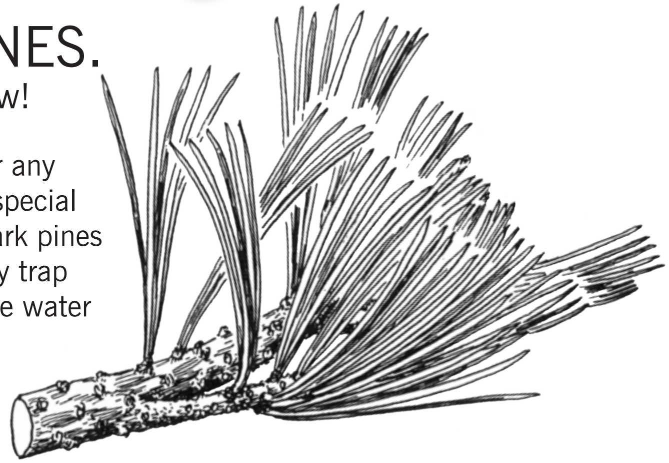
United States Fish and Wildlife Service (USFWS). 2022b. Recovery Outline for Whitebark Pine. December 15th. https://ecos.fws.gov/docs/recovery_plan/20221215_WBP_Final_Recovery_Outline_v11_DRDsigned.pdf [Accessed 19 June 2024] NOTE: This reference will no longer be accessible once the recovery plan is issued.

United States Forest Service (USFS)-Region 1. 2022. Draft Categories of Design Elements/ Conservation Measures Based on Activities. September 6. Developed in conjunction with the USFWS. Provided by the USFS, Region 1, Missoula, MT.

Needles of five, keep it alive!

Please do not cut WHITEBARK PINES.

If a tree's needles grow in clusters of five, leave it to grow!



Whitebark pines live in the mountains, often in areas too harsh for any other tree. More than 100 kinds of living things depend on these special pines, including bears and many bird species. People love whitebark pines for their beauty and strength, and we also need them because they trap snow in the high country, slowing spring runoff and helping provide water to the valleys in summer.

But whitebark pines are in trouble. Many whitebark forests now contain more dead pines than living ones.

- Blister rust, a non-native fungus, weakens the trees, reduces cone production, and eventually causes death.
- Whitebarks are also killed by bark beetles, and beetle epidemics may increase with global climate change.
- Wildfires may kill whitebark pines, although burned areas are good habitat for seedlings. Careful management of fire is essential.

So remember: *If it has five, let's keep it alive!*

For more information and to learn how you can help,
visit the Whitebark Pine Ecosystem Foundation at www.whitebarkfound.org.

CONSERVATION PROFILE:
SPALDING'S CATCHFLY (*SILENE SPALDINGII*)

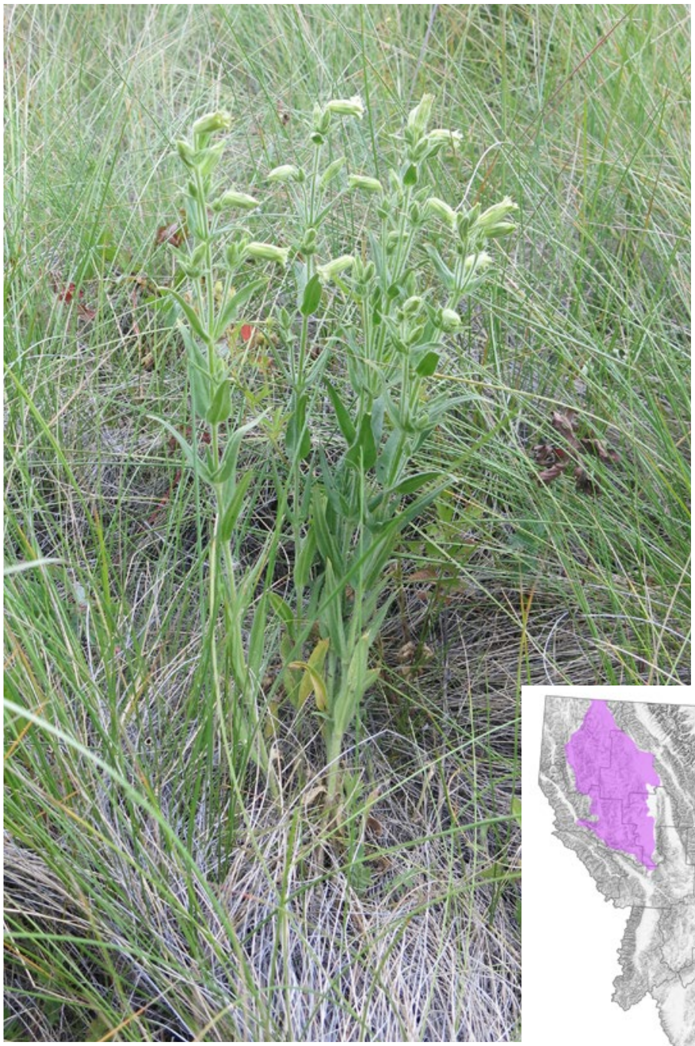
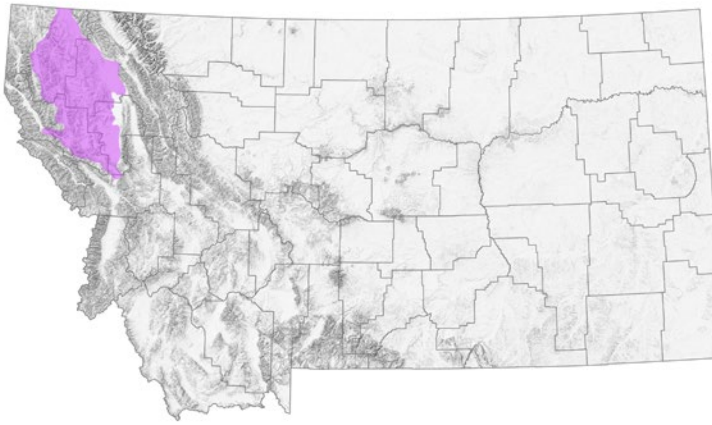


Photo Credit: Beverly Skinner, USFWS

Photo 1. *Spalding's Catchfly grows in open, mesic (montane) grasslands within valleys and foothills.*



Source: Montana Natural Heritage Program (2024a)

Figure 1. The range for Spalding's Catchfly in Montana.

PURPOSE:

This conservation profile provides information about Spalding's Catchfly, a Plant Species of Greatest Conservation Need (GCN) in Montana. It highlights the plant's state-level distribution, factors that put it at risk for loss, and conservation objectives that, if implemented, would aid the persistence of Spalding's Catchfly. This conservation profile aims to be an abbreviated, stand-alone document that can be used by, or shared with, land managers, landowners, educators, decision-makers, regulators, and anyone interested in Spalding's Catchfly. This conservation profile should also be used in conjunction with Section 4 of the Montana Native Plant Conservation Strategy, which addresses overarching conservation objectives for Plant Species of GCN.

INFORMATION ON SPALDING'S CATCHFLY

Distribution, Status, and Identification

Spalding's Catchfly (*Silene spaldingii*) is endemic to western North America where, on a worldwide scale, plants are found sparsely distributed in eastern Washington, northeastern Oregon, northern Idaho, and northwestern Montana in the US, and in southeastern British Columbia, Canada (Morton in *Flora of North America* 2005). In Montana, plants were first documented in 1894. Today the species is found in discrete areas of northwest Montana where it grows within grasslands in intermontane valleys (Montana Natural Heritage Program (MTNHP) 2024a) (Photo 1; Figure 1).

In 2001, Spalding's Catchfly was federally listed as threatened under the Endangered Species Act (ESA) of 1973, as amended, by the US Fish and Wildlife Service (USFWS) (2007). In 2007 the USFWS issued a recovery plan[1] to protect and maintain reproducing, self-sustaining populations of Spalding's Catchfly in each of the five distinct physiographic regions where it resides. The most recent five-year review[2] of its status was completed by the USFWS in 2020 (USFWS 2020).

Spalding's Catchfly is a Montana Species of Concern (SOC) plant as determined by the MTNHP (MTNHP 2024b). Ranked in the state as S2, Spalding's Catchfly is at risk to extirpation in the state because of very limited and/or potentially declining population numbers, range, and/or habitat (MTNHP 2024b).

Learn about Spalding's Catchfly's identification, biology, and state status in the Montana Field Guide[3]

Learn about Spalding's Catchfly's range-wide information and federal status in the USFWS Environmental Conservation Online Systems (ECOS)[4]

Photo Credit: Andrea Pipp

Photo 2. A Confederated Salish and Kootenai Tribal botanist, assisted by a Salish Kootenai College student monitors Spalding's Catchfly in support of the recovery plan.

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[1] Recovery Plan for *Silene spaldingii* (Spalding's Catchfly): https://ecos.fws.gov/docs/recovery_plan/071012.pdf

[2] Five-Year Review for *Silene spaldingii*: https://www.fws.gov/species/spaldings-catchfly-silene-spaldingii

[3] Montana Field Guide, Spalding's Catchfly: https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PDCAR0U1S0

[4] USFWS ECOS website: https://ecos.fws.gov/ecp/species/3681

RATIONALE FOR PLANT SPECIES OF GREATEST CONSERVATION NEED

Spalding's Catchfly is a Plant Species of Greatest Conservation Need (GCN) in Montana because of its rarity and threats that put populations at risk of state extirpation. Plants typically grow in clustered occurrences that are widely scattered within four distinct geographical areas of Montana. Occurrences are often composed of fewer than 150 plants, but depending upon the site can range in size from a single individual to a thousand plants (MTNHP 2024a). Obtaining information on population size, habitat condition, distribution, and other factors is complicated by the fact that plants go through a dormancy period and are often difficult to find when not flowering or fruiting.

Major threats to the persistence of Spalding's Catchfly are from vectors that harm its habitat, predominantly invasive non-native plant species, fire suppression, and ecologically incompatible livestock grazing (MTNHP 2021; USFWS 2007). Invasive non-native plant species detrimentally affect Spalding's Catchfly plants by altering pollinator behavior, competing for water and nutrients, and altering ecosystem attributes, such as microclimates, fire ecology, hydrology, and nutrient cycling (USFWS 2007). In teracting with non-native plant invasions are altered historic fire regimes and grazing systems. In the absence of fire or grazing, plant litter (thatch) can build up in grasslands, potentially reducing plant vigor, smothering germination, or reducing recruitment for Spalding's Catchfly (Lesica 1999; Lesica 2005; USFWS 2007). Ecologically incompatible livestock grazing can trample and remove reproductive plants, compact soil, and degrade habitat. Conversely, proper timing, frequency, and duration of livestock grazing can benefit Spalding's Catchfly populations and maintain habitat (Pipp 2020). Likewise, fire can also hinder or help Spalding's Catchfly depending upon the timing, severity, and frequency (USFWS 2007; USFWS 2020).

Photos: Andrea Pipp

*Photo 3. Within native, intact Rough Fescue (*Festuca campestris*) habitat, the noxious Sulphur Cinquefoil (*Potentilla recta*) weed finds a foothold in a narrow, ephemeral drainage. Flathead Indian Reservation, Montana.*

CONSERVATION GOALS & OBJECTIVES FOR SPALDING'S CATCHFLY

The intent of the *Montana Native Plant Conservation Strategy: Species and Habitats of GCN* is to promote the collective and coordinated stewardship of Montana's Plant Species of GCN to ensure their viability and persistence using a fusion of approaches. Sections 3-*Strengthening Botanical Capacity* and 4-*Plant Species of GCN* present overarching goals and conservation objectives that can indirectly - help sustain Spalding's Catchfly populations. In this conservation profile we present conservation objectives specific to Montana's Spalding's Catchfly populations from four areas that are pillars to plant conservation:

- Information Needs [Inventory, Monitoring, Research]
- Protection and Restoration
- Outreach and Education
- Policy and Regulation

The conservation objectives were developed by a Spalding's Catchfly Working Group that met in December 2022, and are based on published research, monitoring, professional expertise, and field observations. The working group consisted of biologists, ecologists, botanists, and researchers working for federal and state land management agencies, Tribal Nation, non-governmental organizations, consulting business, and others (see Table 1 on page *iii* of the Strategy). Working within and across jurisdictional boundaries, these conservation objectives are voluntary and intended to empower federal, state, Tribal, and non-government conservation land managers, landowners, businesses, and individuals who want to contribute to or collaborate on processes that could aid Spalding's Catchfly persistence on the landscape. They can be pursued or implemented by a single entity, or as a collaborative effort by individuals, agencies, and organizations. They are presented in no prioritized order.

Photo Credit: Andrea Pipp

Photo 4. Monitoring Spalding's Catchfly on the Flathead Indian Reservation - through healthy, intact native Rough Fescue grassland.

Information Needs [Inventory, Monitoring, Research]

Conservation Goal

Improve scientific understandings of Spalding's Catchfly in Montana and the ecological and cultural processes that sustain plants and habitat through statewide coordination, inventory, monitoring, and research.

Conservation Objectives

1) Work collaboratively with federal, state, Tribal, and private landowner partners to acquire necessary field data and share the information with MTNHP to conduct the following assessments:

   a. Review and Revise Species Occurrence Ranks (SO-Ranks). An SO-Rank represents the overall "quality" of the site based on an assessment of the plant's population size, habitat quality, landscape context, and abiotic and biotic conditions. Updated and accurate SO-Ranks are used by managers in planning projects, prioritizing occurrences for restoration, identifying reference sites, and aiding management decisions. SO-Ranks should be reviewed and revised on a five- to ten-year cycle.

   As of 2023, 50% of Spalding's Catchfly occurrences have been ranked, creating useful information that is also a priority for updating (Box 1). Acquiring revisit data on SOs and updating SO-Ranks at regular -intervals creates a tool for inferring trend (stable, improving, or degrading) for the site.

   b. Evaluate and Update State Threat Score and rationale. Spalding's Catchfly has a Very High threat score based on the 2021 Threat Assessment by MTNHP (MTNHP 2021a). The State Threat Score and rationale should be updated by MTNHP at five-year intervals, or as warranted by current data. Reported threats and data analysis should be posted on the Montana Field Guide to create transparency in the ranking process. The State Threat Score represents the degree to which the target plant is degraded by extrinsic factors, which are characterized in terms of timing, severity, and scope (MTNHP 2021b; Master et al. 2012).

Box 1. Status of SO-Ranks for 74 extant Spalding's Catchfly occurrences as of 2023:

- 38 lack SO-Rank
- 25 ranked in 2009
- 1 ranked in 2012
- 6 ranked in 2018
- 1 ranked in 2019
- 4 ranked in 2020

2) Collaborate with landowners to seek input and permissions to conduct consecutive years of surveys on lands identified as having high-to-moderate suitability by the most current Predicted Suitable Habitat Model. Consider providing survey results (both present and absent observations) to MTNHP to help refine the Predicted Suitable Habitat Model for Spalding's Catchfly in Montana. Three consecutive years of monitoring is recommended to significantly improve detection for presence (USFWS 2012). Landowners with whom to collaborate include:

   - Private landowners
   - NGO landowners, specifically The Nature Conservancy (TNC)
   - State land management agencies, specifically MT DNRC
   - ` Federal land management agencies
   - Tribal nations, specifically the Confederated Salish and Kootenai Tribes (CSKT)

Information Needs [Inventory, Monitoring, Research]

3) Where known populations of Spalding's Catchfly plants occur, collaborate with landowners to seek input and permissions to conduct consecutive years of surveys at least once in a 10-year period -to obtain current data on population size, threats, and habitat condition and to track trends. Consider providing survey results (both present and absent observations) to MTNHP for inclusion in the botany database. Three consecutive years of monitoring is recommended to significantly improve detection for presence (USFWS 2012). Landowners with whom to collaborate include:
   - Private landowners
   - NGO landowners, specifically TNC
   - State land management agencies, specifically MT DNRC
   - ` Federal land management agencies
   - Tribal nations, specifically the Confederated Salish and Kootenai Tribes (CSKT)

4) Work to retain the monitoring schedule and data collection methods to ensure that the 20-year monitoring window is completed and in compliance with the *Silene spaldingii* recovery plan (USFWS 2007) for the established transects on the Flathead Indian Reservation (Sullivan Gulch and Crosson Valley/Sullivan Hill areas), USFWS-Lost Trail National Wildlife Refuge (NWR), and The Nature Conservancy-Dancing Prairie Preserve.
   a. Work to retain and/or improve partnerships and secure funding among MTNHP, Confederated Salish and Kootenai Tribes, Lost Trail NWR, and USFWS (Regions 1 and 6 and Montana Ecological Services) to conduct and fund established monitoring work on the Flathead Indian Reservation.
   b. Retain and build collaboration among MTNHP, the Confederated Salish and Kootenai Tribes, Montana Fish, Wildlife & Parks, Lost Trail NWR, USFWS (Region 6 and Montana Ecological Services), The Nature Conservancy, private landowners, and botanical consultants to fund and collect data from established monitoring transects.

Photo Credit: Beverly Skinner

Photo 5. Monitoring Spalding's Catchfly plants on the Lost Trail National Wildlife Refuge through healthy native Rough Fescue grassland

Information Needs [Inventory, Monitoring, Research]

   c. Work cooperatively with federal, state, and NGO land managers to conduct revisits to SOs that are not part of an established monitoring effort, at a frequency of at least once every ten years. Strive to obtain current population (negative and positive), habitat, threat, and mapping data that is shared with MTNHP and to conduct SO ranking every five to ten years.
   d. Bolster partnerships with private landowners to support other monitoring efforts.

5) Use existing resources to find literature, research studies, and other information when investigating research questions or needs and designing monitoring studies. Across Spalding's Catchfly's range information has accumulated from a variety of sources including academic research, federal and state research and management reports, and observation data, on topics of life history traits, ecology and habitat requirements, germination, growth, and transplanting, pollinators, livestock grazing and management, fire ecology, and others. Reference material already compiled can be found at the following sources:
   - Cited and Additional References section in the Montana Field Guide Spalding's Catchfly profile[1]
   - USFWS ECOS website[2]
   - Spalding's Catchfly Technical Team Lead Office[5]

6) Research topics that could further our understanding of this unique plant and/or assist in plant conservation efforts include, but are not limited to:
   a. Conduct research on seed viability and germination trials for Spalding's Catchfly plants representing the range of variability in elevation, geography, population size, and habitat in Montana for the purpose of storing seeds, both for the short and long term.
   b. Work towards developing compatible land management practices for Spalding's Catchfly in Montana using long-term research experiments and monitoring to evaluate the response of Spalding's Catchfly plants under various types of livestock grazing and agricultural practices. Previous published research has studied the effects of agricultural practices and livestock management on Spalding's Catchfly plants and populations in other states.

Photo Credit: Andrea Pipp

Photo 6. Insects get trapped in the glandular hairs that cover a Spalding's Catchfly plant.

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[5] USFWS, Idaho Fish and Wildlife Office:
-General contact information: https://www.fws.gov/office/idaho-fish-and-wildlife/contact-us
-Spalding's Catchfly information: https://www.fws.gov/species/spaldings-catchfly-silene-spaldingii

Information Needs [Inventory, Monitoring, Research]

c. Work towards developing compatible land management practices for Spalding's Catchfly in Montana using long-term research experiments and monitoring that evaluates the responses of Spalding's Catchfly plants, nonnative vegetation, and habitat condition to various attributes (timing, duration, intensity, severity, and others) of prescribed fire. Based on a small number of plots, a study on the Dancing Prairie Preserve indicated that prescribed fire in the spring can increase recruitment of Spalding's Catchfly (Lesica 1999; Lesica 2005). In addition, monitoring after a prescribed fire could help determine if plants are in a true decline or in an extended period of dormancy (Lesica 1999).

d. Collaborate with the Spalding's Catchfly Technical Team and literature library to continue research on techniques for growing, planting, and establishing plants in Montana.

e. Develop studies that incorporate monitoring to evaluate the responses of plants to livestock grazing practices (i.e., timing and intensity), specifically in Montana.

f. Develop short-term and long-term studies that examine plant community responses to herbicide treatments and prescribed fire in areas with Spalding's Catchfly populations.

Protection and Restoration

Conservation Goal

Secure on-the-ground, site-specific habitat and/or management protection or restoration for Spalding's Catchfly on public, Tribal, and private lands.

Conservation Objectives

1) Support and encourage the development of Habitat Management Plans for proposed Key Conservation Areas by land management agencies, Tribes, and NGOs, as recommended by the Recovery Plan for *Silene spaldingii* (USFWS 2007).

2) Develop partnerships between federal, state, non-profit, and/or private organizations within the Montana range for Spalding's Catchfly and the following potential facilities to conduct seed banking, germination trials, genetic research, and/or other topics related to collected Spalding's Catchfly plant materials:
    - Rae Selling Berry Seed Bank, Portland State University, Oregon[6]
    - Plant Germplasm Introduction Test and Research Unit, Pullman, Washington

3) Work collaboratively with federal, state, and tribal agencies and NGOs to obtain permits and collect seed for short- and long-term storage from Spalding's Catchfly populations and co-occurring, common or dominant native plant species for use in restoration and other projects. Seed collection of the dominant species that make up the community would facilitate restoring the native habitat. Seed collection should represent species' range of elevation, geography, landownership, and habitat.

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[6] Rae Selling Berry Seed Bank: https://www.pdx.edu/seed-bank/

Protection and Restoration

4) Provide incentive-based programs to conserve, enhance, and restore habitats that support Spalding's Catchfly. Tools could include long-term conservation leases, conservation easements, grazing system development, seeding projects, and invasive species control. Programs that could help include, but are not limited to:
   - MFWP Habitat Montana Program[7]
   - Montana Association of Land Trusts[8]
   - Montana NRCS Agricultural Conservation Easement Programs (ACEP) for Agricultural Land Easements (ALE)[9]

5) Examine opportunities to restore or maintain habitat on public lands through prescribed fire.

6) Develop guidelines for applying herbicides in areas with Spalding's Catchfly. When controlling invasive plants with an herbicide, spot treatments using the appropriate chemical, timing, and concentration can be compatible with retaining Spalding Catchfly populations.

Outreach and Education

Conservation Goal

Facilitate the stewardship of Spalding's Catchfly plants and habitat through education, outreach, and coordination.

Conservation Objectives

1) Ensure participation from Montana on the Spalding's Catchfly Technical Team - led by the Idaho USFWS (Photo 7). Participants should include working professionals who engage with Spalding's Catchfly biology and/or management in Montana: MTNHP Botanist botanical consultants; federal and state botanists and managers; TNC land managers; CSKT botanists and biologists; and private landowners.

Photo Credit: Andrea Pipp

Photo 7. Silene spaldingii *Technical Team members inspect Spalding's Catchfly seedlings that were grown from seed and planted into a palouse prairie remnant at Steptoe Butte in Washington.*

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[7] Habitat Montana: https://fwp.mt.gov/conservation/landowner-programs/habitat-montana

[8] Montana Association of Land Trusts: https://montanalandtrusts.org/

[9] Agricultural Land Easements for Montana: https://www.nrcs.usda.gov/programs-initiatives/acep-agricultural-conservation-easement-program/montana/agricultural

Outreach and Education

2) Ensure that your organization supports and maintains access to the Microsoft Teams site hosted by the Spalding's Catchfly Technical Team and Idaho USFWS. Ensuring access by all organizations into a central repository facilitates information sharing, effective communication, and time management. Information shared includes, but is not limited to: research publications, habitat management plans, planting techniques, monitoring protocols, photographs, meeting notes, mapping, and much more.
3) Revise the Spalding's Catchfly profile on the Montana Field Guide to current MTNHP standards to update and expand known information on life history, ecology, fire ecology, population counts and trends, genetics, germination, transplant experiments, pollination biology, identification, biological characteristics, economics, rangeland management, threats, taxonomy, and other interesting facts; create links to the Strategy and other online information; and improve its readability.
4) Foster partnerships with the CSKT, Salish Kootenai College, and other Tribal organizations in the vicinity of the Flathead Indian Reservation to help increase awareness and educational outreach on Spalding's Catchfly.
5) Foster partnerships between Montana Native Plant Society (MNPS), MTNHP, and environmental educational organizations to develop teaching curricula on Plant Species of GCN, including Spalding's Catchfly.
6) Through the MNPS, conduct field trips to known Spalding's Catchfly sites to expand public awareness about the plant, its habitat, status, and other interesting information.

Policy and Regulation

Conservation Goal

Improve conservation of Spalding's Catchfly through public participation and implementation of existing policies and regulations in cooperation with federal, state, and Tribal land managers, private landowners, and other interested stakeholders.

Conservation Objectives

1) Continue support for the implementation of the 2007 Recovery Plan for *Silene spaldingii* (USFWS 2007).
2) Support Key Conservation Area recognition for Spalding's Catchfly at the Sullivan Gulch and Crosson Valley/Sullivan Hill areas on the Flathead Indian Reservation, USFWS-Lost Trail National Wildlife Refuge, and The Nature Conservancy-Dancing Prairie Preserve (USFWS 2007).
3) Acknowledge and adhere to Tribal laws, ordinances, regulations, and policies, and protect Traditional Knowledge of plants, including Plant Species of GCN, as the intellectual property of Tribal Nations and individual Tribal members, including seeds, propagules and other plant parts occurring on Tribal jurisdictional lands. Refer also to Section 3, Policy and Regulation Conservation Objective, #4.

REFERENCES

Lesica, P. 1999. Effects of fire on the demography of the endangered, geophytic herb *Silene spaldingii* (Caryophyllaceae). American Journal of Botany 86 (7):996-1002.

Lesica, P. 2005. Monitoring Population Trend of *Silene spaldingii* on Dancing Prairie Preserve. Progress Report. - Prepared for The Nature Conservancy, Montana Field Office, Helena, MT.

Master, L., D. Faber-Langendoen, R. Bittman, G. Hammerson, B. Heidel, L. Ramsay, K. Snow, A. Teucher, and A. Tomaino. 2012. *NatureServe Conservation Status Assessments: Factors for Evaluating Species and Ecosystem Risk*. NatureServe, Arlington, VA.

Montana Natural Heritage Program (MTNHP). 2021a. An assessment of threat data reported for *Silene spaldingii*. MTNHP Botany Database. Helena, MT.

Montana Natural Heritage Program. 2021b. Conservation Status Assessment Definitions, Process, Rank Factors, and Calculation of State Ranks for Montana Species. 18 p.

Montana Natural Heritage Program (MTNHP). 2024a. *Silene spaldingii* observation data in the Botany database. Helena, MT. [Accessed 24 April 2024]

Montana Natural Heritage Program (MTNHP). 2024b. *Silene spaldingii* profile on the Montana Field Guide, Helena, MT. https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PDCAM0A010 [Accessed 24 April 2024]

Morton, John. 2005. *Flora of North America North of Mexico, Volume 5, Part 2: Magnoliophyta: Caryophyllidae*. New York: Oxford Press.

Pipp, Andrea. 2020. Three-year baseline monitoring study for *Silene spaldingii* on the Flathead Indian Reservation: Year 2019 and 2017-2019 summary. May15th. Report to the Confederated Salish and Kootenai Tribes of the Flathead Reservation, Pablo, MT and USFWS Montana Ecological Servies Field Office, Helena, MT. Prepared by the Montana Natural Heritage Program, Helena, MT. 84 pp.

US Fish and Wildlife Service (USFWS). 2007. Recovery Plan for *Silene spaldingii* (Spalding's Catchfly). USFWS, Portland, OR. xiii + 187 pp.

US Fish and Wildlife Service (USFWS). 2012. Guidelines for Monitoring Trend of *Silene spaldingii* Populations in Key Conservation Areas. Idaho USFWS Office, Boise, ID. 10 pp.

US Fish and Wildlife Service (USFWS). 2020. Five-Year Review for *Silene spaldingii* (Spalding's Catchfly). September. USFWS, Idaho Fish and Wildlife Office, Boise, ID. 48 pp.

Photo Credit: Peter Lesica

*Photo-9. Native Rough Fescue (*Festuca campestris*) grassland with Spalding's Catchfly and American Harebell (*Campanula rotundifolia*) on the Dancing Prairie Preserve managed by The Nature Conservancy. Montana.*

CONSERVATION PROFILE:
UTE LADIES'-TRESSES (*SPIRANTHES DILUVIALIS*)

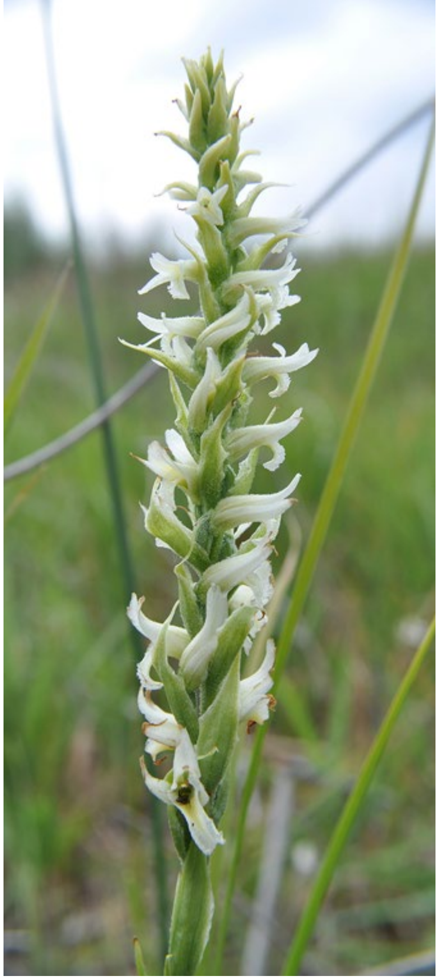
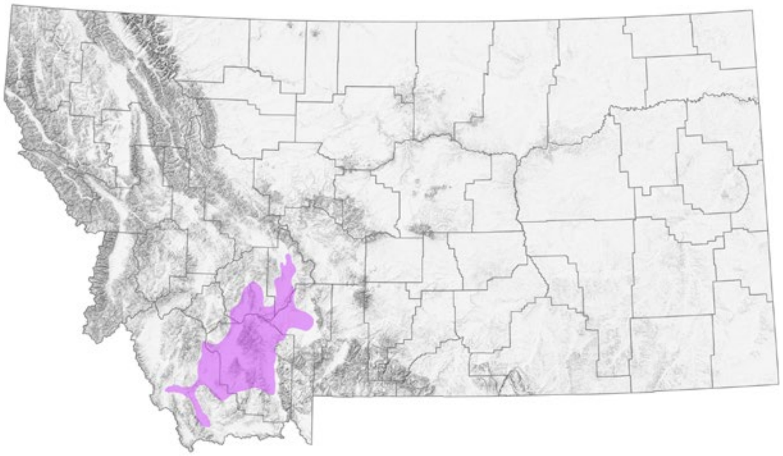


Photo Credit: Andrea Pipp

Photo 1. Ute Ladies'-tresses are members of the Orchid Family and endemic to the US.



Source: Montana Natural Heritage Program (2024a)

Figure 2. The range for Ute Ladies'-tresses in Montana.

PURPOSE:

This conservation profile provides information about Ute Ladies'-tresses, a Plant Species of Greatest Conservation Need (GCN) in Montana. It highlights the plant's state-level distribution, factors that put it at risk for loss, and conservation objectives that, if implemented would aid the persistence of Ute Ladies'-tresses. This conservation profile aims to be an abbreviated, stand-alone document that can be used by, or shared with, land managers, landowners, educators, decision-makers, regulators, and anyone interested in Ute Ladies'-tresses. This conservation profile should also be used in conjunction with Section 4 of the Montana Native Plant Conservation Strategy, which addresses overarching conservation objectives for Plant Species of GCN.

INFORMATION ON UTE LADIES'-TRESSES

Distribution, Status, and Identification

Ute Ladies'-tresses (*Spiranthes diluvialis*) is an orchid, endemic to the US (Sheviak and Brown in Flora of North America [FNA] 2002) (Photo 1). Worldwide, plants are sparsely found in eight states (CO, ID, MT, NE, NV, UT, WA, and WY) in the interior western US and in southern British Columbia, Canada (USFWS 2023a).

In 1992, Ute Ladies'-tresses was federally listed as threatened under the Endangered Species Act (ESA) of 1973, as amended, by the US Fish and Wildlife Service (USFWS 1992). A draft recovery plan was developed in 1995 but never finalized (USFWS 1995). In 2023, a Species Status Assessment (SSA) was completed, found predominantly extant populations, and based on extensive analysis, concluded that the species is not in danger of extinction throughout all of its range (USFWS 2023a). The subsequent Five Year Review recommended de-listing the plant from the ESA (USFWS 2023b). However, until there is further action by the USFWS, Ute Ladies'-tresses remains federally threatened.

Although Ute Ladies'-tresses was federally listed in 1992, it was not until 1994 that the species was documented in Montana (Montana Natural Heritage Program (MTNHP) 2022a). Since then, plants have been documented in the valleys of the Beaverhead, Lower Gallatin, Lower Jefferson, Upper Jefferson, Upper Missouri, and Ruby River drainages (Figure 1; MTNHP 2022a). Populations occur predominantly on privately-owned lands with some occurrences on state-owned lands (MTNHP 2022b). Ute Ladies'-tresses is a Montana Species of Concern (SOC) as determined by the Montana Natural Heritage Program (MTNHP) (2024b). Ranked in the state as S1S2, Ute Ladies'-tresses is at risk to highly at risk of extirpation in the state because of very limited to extremely limited and/or potentially declining to rapidly declining population numbers, range, and/or habitat (MTNHP 2024b).

Learn about Ute Ladies'-tresses' identification, biology, and state status in the Montana Field Guide[1]

Learn about Ute Ladies'-tresses' range-wide information and federal status in the USFWS Environmental Conservation Online Systems (ECOS)[2]

RATIONALE FOR PLANT SPECIES OF GREATEST CONSERVATION NEED

Ute Ladies'-tresses is a Plant Species of Greatest Conservation Need (GCN) in Montana because of its rarity, threats, and a lack of information. In Montana, Ute Ladies'-tresses typically have low population counts and are found in a small number of locations within moist, low-elevation valleys where habitat is limited and fragmented by human development (MTNHP 2024a). They grow in calcareous wetlands, wet meadows, swales, and old meander channels that are outside of active stream channels (Heidel 2001; Lesica et al. 2012). Populations are maintained by seasonal flooding, grazing, and other disturbances that help -retain a sparser density of vegetation or an early-seral habitat (Heidel 2001; Fertig 2005).

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[1] Montana Field Guide, Ute Ladies'-tresses: https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PMORC2B100

[2] USFWS ECOS website: https://ecos.fws.gov/ecp/species/2159

Montana's populations continue to face a variety of threats, including hydrological changes, weed invasion, broad-based herbicide application, development, and also, a lack of disturbance (MTNHP 2021; Fertig et al. 2005). Certain agricultural and ranching practices can help maintain the plant and its habitat if managed and timed appropriately with its flowering and fruiting life stages (Arft 1995, Fertig 2000, Murphy 2001). Populations predominantly occur on privately-owned lands where current data on plant counts, habitat condition, and precise mapping is needed to accurately assess the plant's status (MTNHP 2022b). Yet acquiring this information often requires three consecutive years of surveying because plants can go through a prolonged dormancy period and must be in flower or fruit (July-August) to be easily spotted.

Photo Credit: Andrea Pipp

Photo 2. Ute Ladies'-tresses occupy small wet meadows and swales within valleys that are also used for roads, railroads, and other infrastructure.

CONSERVATION GOALS & OBJECTIVES FOR UTE LADIES'-TRESSES

The intent of the *Montana Native Plant Conservation Strategy: Species and Habitats of GCN* is to promote the collective and coordinated stewardship of Montana's Plant Species of GCN to ensure their viability and persistence using a fusion of approaches. Sections 3-*Strengthening Botanical Capacity* and 4-*Plant Species of GCN* present overarching goals and conservation objectives that indirectly can help sustain Ute Ladies'-tresses populations. In this conservation profile we present conservation objectives specific to Montana's Ute Ladies'-tresses from four areas that are pillars to plant conservation:

- Information Needs [Inventory, Monitoring, Research]
- Protection and Restoration
- Outreach and Education
- Policy and Regulation

The working group consisted of biologists, ecologists, botanists, rangeland management specialists, and researchers working for federal and state land management agencies, non-governmental organizations (NGOs), consulting businesses, and other organizations (see Table 1 on page *iii* of the *Strategy*). Working within and across jurisdictional boundaries, these conservation objectives are voluntary and intended to empower federal, state, Tribal, and non-government conservation land managers, landowners, businesses, and individuals who want to contribute to or collaborate on processes that could aid Ute Ladies'-tresses persistence on the landscape. These objectives can be pursued or implemented by a single entity, or as a collaborative effort by individuals, agencies, and organizations. They are presented in no prioritized order.

Information Needs [Inventory, Monitoring, Research]

Conservation Goal

Improve scientific understandings of Ute Ladies'-tresses in Montana and the ecological and cultural processes that sustain plants and habitat through statewide coordination, inventory, monitoring, and research.

Conservation Objectives

1) Work collaboratively with state agencies, private landowners, NGOs, and other organizations to acquire necessary field data and share the information with MTNHP to conduct the following assessments:

    a. Review and Revise Species Occurrence Ranks (SO-Ranks). An SO-Rank represents the overall "quality" of the site based on an assessment of the plant's population size, habitat quality, landscape context, and abiotic and biotic conditions. Updated and accurate SO-Ranks are used by managers in planning projects, prioritizing occurrences for restoration, identifying reference sites, and aiding management decisions. SO-Ranks should be reviewed and revised on a five- to ten-year cycle.

    As of 2023, 71% of the 28 extant Ute Ladies'-tresses occurrences were ranked in 2009, and are in need of a re-assessment, and 29% are in need of a full assessment (Box 1). Acquiring revisit data on SOs and updating SO-Ranks at regular intervals creates a tool for inferring trend (stable, improving, or degrading) for the site.

    Box 1. Status of SO-Ranks for 29 Ute Ladies'-tresses occurrences as of 2023:

    - 8 lack SO-Rank
    - 20 ranked in 2009
    - 1 ranked in 2012 as extirpated

    b. Evaluate and Update State Threat Score and rationale. Ute Ladies'-tresses has a State Threat Score of high based on the 2021 Threat Assessment (MTNHP 2021a). The State Threat Score and rationale should be updated by MTNHP at five-year intervals, or as warranted by current data. Reported threats and data analysis should be posted on the Montana Field Guide to create transparency in the ranking process. The State Threat Score represents the degree to which the target plant is degraded by extrinsic factors, which are characterized in terms of timing, severity, and scope (MTNHP 2021b; Master et al. 2012).

Information Needs [Inventory, Monitoring, Research]

2) Work with private landowners or with members from the Missouri Headwaters Partnership, Montana Watershed Coordination Council, Gallatin Valley Land Trust, and/or other local organizations to develop relationships with private landowners who have Ute Ladies'-tresses plants on their properties. Facilitate conversations with - landowners about their concerns, observations and knowledge of the plant, permissions to access habitat, ability to conduct revisits or acquire plant counts and habitat condition data, and address other needs. Conducting consecutive years of surveys at least once in a 10-year period helps to maintain accurate status and trend assessments. Consider providing survey results (both present and absent observations) to MTNHP for inclusion in the botany database. Three consecutive years of monitoring is recommended to significantly improve detection for presence.

3) Collaborate with private landowners to seek input and permissions to conduct consecutive years of surveys on lands identified as high or moderate suitability by the most current Predicted Suitable Habitat Model. Consider providing survey results (both present and absent observations) to MTNHP to help refine the Predicted Suitable Habitat Model for Ute Ladies'-tresses in Montana. Three consecutive years of monitoring is recommended to significantly improve detection for presence.

Photo Credit: Andrea Pipp

Photo 3. A population of Ute Ladies'-tresses that is sustained, in part, by ecologically compatible livestock grazing management in Montana.

Information Needs [Inventory, Monitoring, Research]

4) Collaborate with state land management agencies to seek input and permissions to conduct consecutive years of surveys on lands identified as high or moderate suitability by the most current Predicted Suitable Habitat Model. Share survey results (both present and absent observations) to MTNHP to help refine the Predicted Suitable Habitat Model for Ute Ladies'-tresses in Montana. Three consecutive years of monitoring is recommended to significantly improve detection for presence.

5) Collaborate with state land management and Gallatin County government agencies who have Ute Ladies'-tresses on their parcels to seek input, work to acquire funding and/or field assistance, and obtain permissions to conduct consecutive years of surveys. Conducting consecutive years of surveys at least once in a 10-year period helps to maintain accurate status and trend assessments. Consider providing survey results (both present and absent observations) to MTNHP for inclusion into the botany database. Three consecutive years of monitoring is recommended to significantly improve detection for presence.

6) Collaborate with federal and county agencies and other landowners to seek input and permissions to conduct consecutive years of surveys on lands identified as high or moderate suitability by the most current Predicted Suitable Habitat Model. Consider providing survey results (both present and absent observations) to MTNHP to help refine the Predicted Suitable Habitat Model for Ute Ladies'-tresses in Montana. Three consecutive years of monitoring is recommended to significantly improve detection for presence. Share survey results (both present and absent observations) to MTNHP for inclusion in the botany database.

7) Support the ongoing data (population monitoring and trend assessments) collection and mapping conducted by Montana Department of Transportation (MDT) biologists on their right-of-way, leased, and owned parcels. This dataset continues to accumulate long-term population counts for flowering individuals, habitat conditions, and other information used to accurately inform status assessments, project planning, and management actions.

8) Collaborate with all landowners to acquire revisit data from known Ute Ladies'-tresses occurrences on a frequency of at least once every ten years. Revisits could be coordinated with a Montana Citizen Botany Program (see Section 3, Information Need Conservation Objectives, #4). Recognize that at least two consecutive years of monitoring are recommended to accurately determine presence; additional consecutive years of monitoring are best for collecting population data.

9) Re-establish the 2001 demography study conducted by the MTNHP at Piedmont Swamp in Jefferson County (Heidel 2001). This is Montana's only demographic study for Ute Ladies'-tresses that collected life-stage and reproductive data on individual plants from 1996 to 2000. Re-establishing this study using the same methodology could provide insights into long-term population and habitat trends for the species.

Information Needs [Inventory, Monitoring, Research]

10) Use existing resources to find literature, research studies, and other information when investigating research questions or needs and designing monitoring studies. Across Ute Ladies'-tresses range, information has accumulated from a variety of sources including academic research, federal and state research and management reports, and observation data, on topics of life history traits, ecology and habitat requirements, germination, growth, and transplanting, pollinators, livestock grazing and management, fire ecology, and others. Reference material already compiled can be found at the following sources:
    - Cited and Additional References section in the Montana Field Guide Ute Ladies'-tresses profile[1]
    - USFWS ECOS website[2]

11) Research topics that could further our understanding of this unique plant and/or assist in plant conservation efforts include, but are not limited to:
    a. Work towards developing compatible land management practices for Ute Ladies'-tresses in Montana using long-term research experiments and monitoring. Livestock management and agricultural practices have the ability to aid or hinder the persistence of Ute Ladies'-tresses populations. Published literature has not studied the effects of agricultural practices and livestock management on Ute Ladies'-tresses plants and populations in Montana.
    b. Conduct research to develop techniques that can assess the soils for particular types of mycorrhizal fungi that are necessary for Ute Ladies'-tress plants.
    c. Conduct ecological research that aims to document associated vascular species that may be indicators of Ute Ladies'-tresses habitat and its below-ground microbial community.
    d. Conduct research to identify pollinators and study pollination for Ute Ladies'-tresses.
    e. Conduct research on seed viability and germination trials for Ute Ladies'-tress plants representing the range of variability in elevation, geography, population size, and habitat in Montana for the purpose of storing seeds, both for the short and long terms.

Photo Credit: Clare A. Beelman

Photo 4. A hoverfly examines the flowers of a Ute Ladies'-tresses plant. In Montana, studies examining pollination and pollinators relative to this species are needed.

Protection and Restoration

Conservation Goal

Secure on-the-ground, site-specific habitat and/or management protection or restoration for Ute Ladies'-tresses on public and private lands.

Conservation Objectives

1) Provide incentive-based programs to conserve, enhance, and restore habitats that support Ute Ladies'-tresses. Tools could include long-term conservation leases, conservation easements, grazing system development, seeding projects, invasive species control, and funding mechanisms. Programs that could help include, but are not limited to:
    - USFWS Section 6 Grant Program
    - Montana Fish, Wildlife & Parks (MFWP) Habitat Montana Program[3]
    - Montana Association of Land Trusts[4]
    - Montana Natural Resources Conservation Service (NRCS), Agricultural Conservation Easement Programs (ACEP)[5] for Montana:
      -Agricultural Land Easements (ALE)
      -Wetland Reserve Easements (WRE)
2) Work with the Montana Native Plant Society (MNPS), state and county agencies, private landowners, and other conservation organizations in using publicly available data from MTNHP to investigate the possibility of developing an Important Plant Area (IPA) or a State Natural Area for Ute Ladies'-tresses. An IPA is a recognition by MNPS of locations that have outstanding rare and unique plant occurrences. Refer also to Section 4, Outreach and Education, Conservation Objective #5.
3) Use stakeholders (landowners, land management agencies, conservation organizations, botanists, and others) to identify known occurrences where protection or restoration is warranted. Consider using conservation easements to protect known populations. Where restoration is identified as a need, use an interdisciplinary team to develop a restoration plan, avoid negative impacts to existing Ute Ladies'-tresses plants, and use local/state native plant materials. Refer to: Section 3, Protection and Restoration, Conservation Objectives #1 & #5; Section 4, Protection and Restoration, Conservation Objectives #5, #6, #7, & #9.
4) Promote sharing of management guidelines developed by other federal and state agencies for review and potential use by landowners, as appropriate, for populations in Montana.
5) Develop partnerships between federal, state, non-profit, and/or private organizations within the Montana range for Ute Ladies'-tresses and the following potential facilities to conduct seed banking, germination trials, genetic research, and/or related topics relative to collected Ute Ladies'-tresses plant materials:
    - Rae Selling Berry Seed Bank, Portland State University, Oregon[6]
    - Plant Germplasm Introduction Test and Research Unit, Pullman, Washington

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[3] Habitat Montana: https://fwp.mt.gov/conservation/landowner-programs/habitat-montana

[4] Montana Association of Land Trusts: https://montanalandtrusts.org/

[5] NRCS ACEP: https://www.nrcs.usda.gov/programs-initiatives/acep-agricultural-conservation-easement-program/montana/agricultural

[6] Rae Selling Berry Seed Bank: https://www.pdx.edu/seed-bank/

Outreach and Education

Conservation Goal

Facilitate the stewardship of Ute Ladies'-tresses plants and habitat through education, outreach, and coordination.

Conservation Objectives

1) Tell the story of Ute Ladies'-tresses, its unique life history and habitat, and the management practices that can help sustain the plant. Write articles, conduct field trips, present talks, and develop stories for news, social, and web media. Pair people who are knowledgeable on Ute Ladies-tresses with writers, conservation-oriented organizations, local media producers, local and regional governing bodies, and/or educators to provide opportunities to showcase south-central Montana's iconic plant, to bring awareness, promote education, and help foster stewardship for its persistence.

2) Ask the Missouri Headwaters Partnership, Montana Association of Conservation Districts, individual conservation districts, or other Montana-based conservation organizations how to engage private landowners and do public outreach on this plant.

3) Partner with a conservation organization, such as the Missouri Headwaters Partnership, a conservation district, MTNHP, or Montana Native Plant Society, to table/host a booth for educational outreach on Ute Ladies'-tresses and other Montana Species of Concern. Potential events to table or host a booth are:
    - County Fairs in Beaverhead, Broadwater, Gallatin, Jefferson, Madison counties
    - Montana Range Days (when the event occurs within the range of Ute Ladies'-tresses)

4) Foster partnerships with Montana University System faculty, particularly at Montana State University (MSU; Animal and Range Department) and The University of Montana Western (Environmental Sciences) to bring awareness and educational outreach about Ute Ladies'-tresses.

Photo Credit: Ryan Quire

Photo 5. Ute Ladies'-tresses grow in low-elevation valleys where vegetation is less dense and stays green long into the summer because of a shallow groundwater table.

Outreach and Education

5) Foster partnerships with agricultural- and rangeland-focused community and academic organizations - to bring awareness and educational outreach on Ute Ladies'-tresses. Potential organizations to engage with include:
    - Society of Range Management: MSU Range Club
    - Future Farmers of America Chapters: Beaverhead FFA, Twin Bridges FFA, Ruby Valley FFA, and Lima FFA
    - Local 4-H chapters
6) Foster partnerships between Montana Native Plant Society, MTNHP, and environmental education organizations to develop a teaching trunk or curriculum on Montana's Species of Concern plants, including Ute Ladies'-tresses.
7) Conduct field trip to known Ute Ladies'-tresses to foster public awareness of the plant, its habitat, status, and interesting information.
8) Disseminate the 2020 Ute Ladies'-tresses brochure produced by MTNHP[7] to local offices within the known state range to promote awareness and find local landowners interested in conservation:
    - USFS Forest and Ranger District Offices
    - BLM Field Office
    - NRCS Field Offices
    - Missouri Headwaters Partnership
    - Conservation district offices

Policy and Regulation

Conservation Goal

Improve conservation of Ute Ladies'-tresses through public participation and implementation of existing policies and regulations in cooperation with federal and state land managers, private landowners, and other interested stakeholders.

Conservation Objectives

1) Implement actions recommended in the 1995 Draft Recovery Plan for *Spiranthes diluvialis*[8], as appropriate.
2) Through federal and state agency collaboration, continue to provide information and data to the USFWS to help in their assessments, including the five-year review, Species Status Assessment, post-delisting monitoring plant, and others.
3) Support private landowners in their efforts to share plant data with MTNHP and federal agencies.

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[7] Contact the Program Botanist at MTNHP for electronic versions of the brochure. https://mtnhp.mt.gov/

[8] Available on the Ute Ladies'-tresses Montana Field Guide profile: https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PMORC2B100

REFERENCES

Arft, Anna Maria. 1995. "The genetics, demography, and conservation management of the rare orchid *Spiranthes diluvialis*." (PhD thesis, University of Colorado, Boulder, CO 170 pp.

Fertig, W. 2000. Status review of the Ute Ladies'-tresses (*Spiranthes diluvialis*) in Wyoming. Report prepared for the Wyoming Cooperative Fish and Wildlife Research Unit, US Fish and Wildlife Service (USFWS), and Wyoming Game and Fish Department by the Wyoming Natural Diversity Database, Laramie, WY.

Fertig, W., R. Black, and P. Wolken. 2005. Rangewide Status Review of Ute Ladies'-Tresses (*Spiranthes diluvialis*). September 30th. Prepared for the USFWS and Central Utah Water Conservancy District.

Heidel, B. 2001. Monitoring Ute ladies'-tresses (*Spiranthes diluvialis*), in Jefferson County, Montana: final report, 1996-2000. Report to Bureau of Land Management. Montana Natural Heritage Program, Helena, MT. 11 pp. plus appendices.

Lesica, P., M. Lavin, and P. Stickney. 2012. *Manual of Montana Vascular Plants*. Fort Worth, TX: BRIT Press. viii + 771 p.

Master, L., D. Faber-Langendoen, R. Bittman, G. Hammerson, B. Heidel, L. Ramsay, K. Snow, A.Teucher, and A. Tomaino. 2012. *NatureServe Conservation Status Assessments: Factors for Evaluating Species and Ecosystem Risk*. NatureServe, Arlington, VA.

Montana Natural Heritage Program (MTNHP). 2021a. An assessment of threat data reported for Spiranthes diluvilias. MTNHP Botany Database. Helena, MT. [Accessed 31 Deecember 2023]

Montana Natural Heritage Program. 2021b. Conservation Status Assessment Definitions, Process, Rank Factors, and Calculation of State Ranks for Montana Species. 18 p.

Montana Natural Heritage Program (MTNHP). 2024a. *Spiranthes diluvialis* profile on the Montana Field Guide. Helena, MT https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PMORC2B100 [Accessed 15 February 2024].

Montana Natural Heritage Program (MTNHP). 2024b. Data on *Spiranthes diluvialis* observation from the botany database. Helena, MT.

Murphy, C. 2001. Monitoring the Habitat of Ute Ladies' Tresses (*Spiranthes diluvialis*) On the South Fork Snake River, Idaho - Methods and First Year Results. Idaho Department of Fish and Game, Natural Resources Policy Bureau. 32 pp.

Sheviak, C. and P. Brown. 2002. *Flora of North America North of Mexico, Magnoliophyta: Liliidae, Liliales, and Orchidales*. Volume 26. New York:Oxford Press. 723 pp.

US Fish and Wildlife Service (USFWS). 1992. Endangered and threatened wildlife and plants; final rule to list the plant *Spiranthes diluvialis* (Ute ladies' tresses) as a threatened species. Federal Register 57(12):2048-2054.

US Fish and Wildlife Service (USFWS). 1995. Ute ladies' tresses (*Spiranthes diluvialis*) draft recovery plan. USFWS, Denver, CO. 46 pp.

US Fish and Wildlife Service (USFWS). 2023a. Species Status Assessment Report for Ute Ladies'-tresses (*Spiranthes diluvialis*). June- Version 1. Prepared for the Utah Ecological Service Field Office, Salt Lake City, UT.

US Fish and Wildlife Service (USFWS). 2023b. Ute Ladies'-tresses (*Spiranthes diluvialis)*, 5-Year Status Review: Summary and Evaluation. August 1. Prepared for Mountain-Region, Denver, CO.

APPENDIX B

Conservation Profiles for Unique Habitats of GCN

CONSERVATION PROFILE: CENTENNIAL VALLEY SAND DUNES

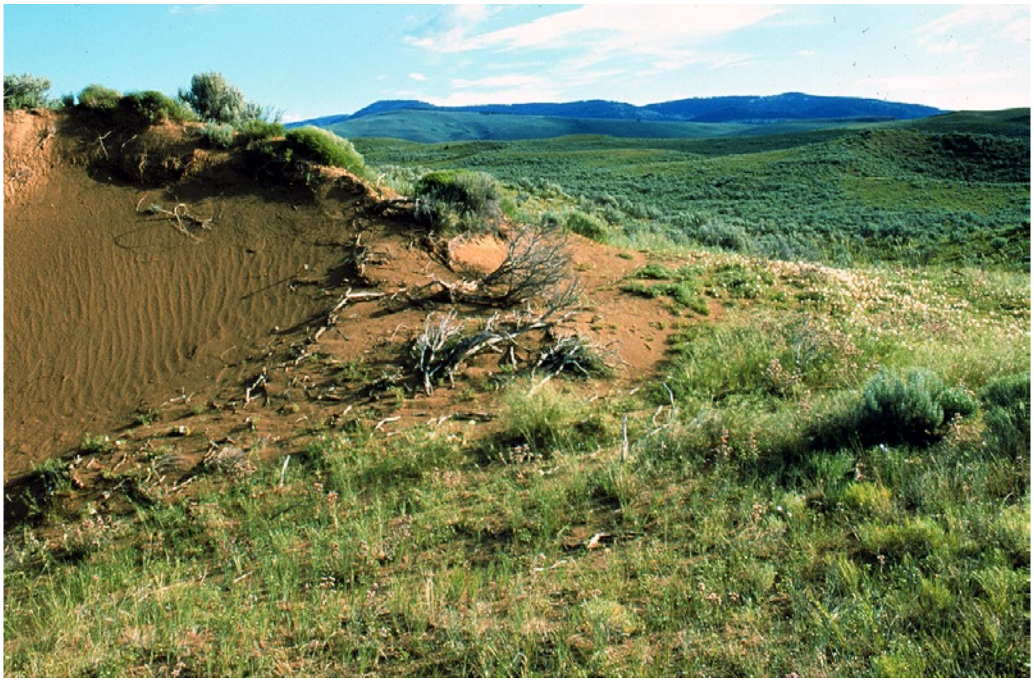

Photo Credit: Peter Lesica

Photo 1. Centennial Valley Sand Dunes in Beaverhead County, Montana.

PURPOSE:

This conservation profile provides information about the Centennial Valley Sand Dunes, Unique Habitat of Greatest Conservation Need (GCN) in Montana. It highlights the sand dunes' unique physical characteristics; its state distribution; ecological values to rare plants and animals; factors that influence this habitat's vulnerability to persistence; and voluntary conservation objectives, that, if continued or implemented, would aid its persistence in Montana. The conservation profile aims to be a brief, stand-alone document that can be used by or shared with land managers, landowners, educators, decision-makers, regulators, and anyone interested in the Centennial Valley Sand Dunes; it may also apply to other areas of sandy deposits that are not associated with a dune system. This conservation profile should also be used in conjunction with Section 5 of the Montana Native Plant Conservation Strategy which addresses overarching conservation objectives for Unique Habitats of GCN.

INFORMATION ON THE CENTENNIAL VALLEY SAND DUNES

Origins of the Centennial Valley Sand Dunes

The Centennial Valley Sand Dunes[1] comprise approximately 3,000 acres of a unique habitat type that occurs in southwest Montana (Photo 1). They are mostly stabilized habitats of the Barchan sand dune system, crests of dunes that mostly parallel the prevailing winds (Wikipedia[2]).

The dunes are a post-Pleistocene feature that developed over time as the once-extensive Red Rock Lakes (or single lake at the time) receded, leaving lakebed sediments and other Quaternary-period depositional materials exposed to prevailing southwesterly winds. The finer materials were eroded away while the coarse-textured sands settled northeast of the source, building into a Barchan dune system. The relatively high elevation (6,680 to 6,720 feet) and low annual precipitation (averaging 20.4 inches over a 46-year period) in the dune area support the development of an Intermountain shrubland or steppe on silty alluvial soils. The area is dominated by several species of sagebrush (Artemisia), mostly Mountain Big Sagebrush (*Artemisia tridentata* var. *vaseyana*), Basin Big Sagebrush (*A. tridentata* var. *tridentata*), and Three-tip Sagebrush (*A. tripartita*). Dominating the undergrowth are Needle-and-Thread Grass (*Stipa comata*) and Idaho Fescue (*Festuca idahoensis*) along with a forb component that is diverse but low in cover. Non-native plant species are uncommon on the dunes. Blowout areas with little or no vegetation dot the landscape.

Location of Montana's Sand Dunes

The dunes are in the Centennial Valley, in the far southeastern portion of Beaverhead County. They occupy at least 3,100 acres. The North Valley Road traverses through a portion of the sand dunes, which is accessed from the Red Rock Pass Road between Henrys Lake, Idaho and Monida, Montana. Additional sites of sand dune habitat may also exist.

Portions of eastern Montana also have areas of sandy deposits which also create a unique habitat. However, they are not associated with a dune system.

Management of Montana's Sand Dunes

The Centennial Valley Sand Dunes stretch across multiple landownerships and conservation easements that are managed by the following organizations:

- US Fish and Wildlife Service (USFWS) lands, including Red Rocks National Wildlife Refuge (NWR)
- Montana/Dakotas Bureau of Land Management (MT/Dakotas BLM)
- Montana Department of Natural Resources and Conservation (MTDNRC), including Montana State Trust Lands
- The Nature Conservancy (TNC)
- Private landowners

Most of the sand dunes are under some degree of protection. Approximately 800 acres in the easternmost portion of the sand dunes are managed by the USFWS (Red Rocks NWR) and another 2,300 acres on the western end of these holdings are managed by the TNC or MT/Dakotas BLM. A portion is in an easement to the USFWS from TNC. The MT/Dakotas BLM manages the Centennial Sandhills Area of Critical Environment Concern (ACEC), which is approximately six miles north of Lakeview Montana[3]. Approximately 1,040 acres of public lands provide habitat for BLM's special status plant species in the ACEC (USDI-BLM 2006). A small fraction of the dune system is privately held land.

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[1] A 'sand dune' is a mound of sand formed by the wind and dunes grow as grains of sand accumulate (Wikipedia 2024); it is technically the more correct term for this unique habitat. A 'sand hill' is a type of ecological community or xeric-wildfire maintained ecosystem (Wikipedia 2024).

[2] Barchan on Wikipedia: https://en.wikipedia.org/wiki/Barchan

There are good working relationships among TNC, private landowners, MT/Dakotas BLM, MTDNRC, and USFWS, and overall support to ensure the persistence of the Centennial Valley Sand Dunes (Berkey 2023). In addition, the Centennial Valley Association (CVA)[4], a landowner-led nonprofit, facilitates community-based conservation (conducting joint projects, education, and conflict resolution) while preserving traditional ranching in the region (Montana Native Plant Conservation Strategy-Centennial Valley Sand Dunes Work Group 2023; CVA 2024).

Unique Ecology and Biological Distinctions

The sand dunes (with soils classified as Typic Cryopsamments) have lost much of their high dune structure and today typically rise to approximately 15 feet above the surrounding terrain, though some may be taller. The dunes themselves have become predominantly rounded and stabilized by sagebrush steppe vegetation. Nonetheless, the Centennial Valley Sand Dunes are thought to be the highest dunes by elevation in the Northern Rocky Mountains. Sand-dominated blowouts occur throughout the dune landscape and are initiated by a variety of disturbance factors, such as fire, domestic livestock grazing, and rodent activity. These blowouts constitute an early successional stage of having low vegetation cover, which is essential to maintaining several of the dunes' unique biological features.

The sand dunes have become an important habitat that supports many rare plant and animal species and rare plant community types in Montana. The sand dunes remain under-surveyed and may support other unique species and community types that are not currently documented.

Rare Vascular Plant Species

The rarest associated plant is Painted Milkvetch (*Astragalus ceramicus* var. *apus*) (MTNHP 2024a). Nearly as rare is the Sand Wildrye (*Elymus flavescens*), for which the Centennial Valley is the only known location in the state of Montana (MTNHP 2024b). Fendler Cat's-eye (*Cryptantha fendleri*) is a third rare plant known to rely on the sand dunes (MTNHP 2024c).

Learn about Painted Milkvetch[5], Sand Wildrye[6], and Fendler Cat's-eye[7] plant identification, biology, and status in the Montana Field Guide.

Rare Animal Species

Several rare animals also associate with these sand dunes. The Columbia Plateau Pocket Mouse (*Perognathus parvus*) is a rare mammal found in southeast Montana where it has been captured on the sand dunes (Hendricks and Roedel 2002; MTNHP 2024d). The Big Sand (*Cicindela formosa*) and Saint Anthony Dune (*C. arenicola*) Tiger Beetles live in the sand dune habitat where they are disjunct from other known populations (MTNHP 2024e and 2024f). The next closest known population of Big Sand Tiger Beetle is approximately 250 miles to the northeast (Hendricks and Lesica 2007). Saint Anthony Dune Tiger Beetle is globally rare and populations are typically found in dune habitat along the Snake River in central Idaho (Bosworth 2010; NatureServe 2024a; MTNHP 2024f); this beetle is also a Montana Species of Concern (SOC) where its only state population is found in the Centennial Valley (MTNHP 2024f). The Western Bumble Bee (Bombus occidentalis) is a Montana SOC insect that has been captured in proximity to sand dune habitat (MTNHP 2022; MTNHP 2024g). Petitioned in 2015 for listing under the federal Endangered Species Act, the status of the Western Bumble Bee is currently being reviewed by the USFWS (Federal Register 2016; USFWS 2024).

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[3] Centennial Valley ACEC map: https://eplanning.blm.gov/public_projects/lup/77497/103609/126896/map8.pdf
[4] Centennial Valley Association: https://www.centennialvalleyassociation.org
[5] Montana Field Guide – Painted Milkvetch: https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PDFAB0F1V1
[6] Montana Field Guide – Sand Wildrye: https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PMPOA6P080
[7] Montana Field Guide – Fendler Cat's-eye: https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PDBOR0A0X0

Photo Credit: Peter Lesica

Photo 2. Sandy dunes and other areas of sandy deposits form a unique habitat that boosts biodiversity in Montana.

Learn about Columbia Plateau Pocket Mouse[8], Big Sand Tiger Beetles[9] and Saint Anthony Dune Tiger Beetles[10], and Western Bumble Bee[11] identification, biology, and status in the Montana Field Guide.

Rare or Unique Plant Communities

The Centennial Valley Sand Dunes are also the only Montana location for three plant associations that may be globally unique or State rare:

- Yellow Rabbitbrush / Needle-and-thread Shrubland (*Chrysothamnus viscidiflorus / Stipa comata* Shrubland)
- Basin Big Sagebrush / Needle-and-thread Shrubland (*Artemisia tridentata* var. *tridentata / Hesperostipa comata* Shrubland, CEGL002966[12]) (NatureServe 2024b)
- Thick-spike Wheatgrass / Silverleaf Phacelia Grassland (*Elymus lanceolatus - Phacelia hastata* Grassland, CEGL001745[13]) (NatureServe 2024c)

Learn about the distribution, ecology, classification, and status of these plant associations in NatureServe Explorer.[12.,13]

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[8] Montana Field Guide – Columbia Plateau Pocket Mouse: https://fieldguide.mt.gov/speciesDetail.aspx?elcode=AMAFD01100

[9] Montana Field Guide – Big Sand Tiger Beetle: https://fieldguide.mt.gov/speciesDetail.aspx?elcode=IICOL02040

[10] Montana Field Guide – St. Anthony Dune Tiger Beetle: https://fieldguide.mt.gov/speciesDetail.aspx?elcode=IICOL02130

[11] Montana Field Guide – Western Bumble Bee: https://fieldguide.mt.gov/speciesDetail.aspx?elcode=IIHYM24252

[12] NatureServe Explorer – CEGL002966: https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.689792/Artemisia_tridentata_ssp_tridentata_-_Hesperostipa_comata_Shrubland

[13] NatureServe Explorer - CEGL001745: https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.684114/Elymus_lanceolatus_-_Phacelia_hastata_Grassland

RATIONALE FOR UNIQUE HABITAT OF GREATEST CONSERVATION NEED

The Centennial Valley Sand Dunes are a Unique Habitat of Greatest Conservation Need (GCN) because they occur in a small portion of Montana, provide habitat for numerous unique and declining species and plant associations, and require particular disturbance regimes to persist. Their limited distribution in southwest Montana makes them an iconic part of Beaverhead County. The unique physical characteristics that create and maintain this habitat have influenced many plant and animal species, contributing significantly to biodiversity found in Montana. Yet in our changing world, the suite of interacting environmental processes that create and maintain the sand dunes are shifting, which threatens their persistence and the rare plants, animals, and plant associations that reside in them.

Natural plant succession is the most significant threat to this unique habitat and the rare species that inhabit them. The rare plants rely on disturbed sites (i.e., “blowout” areas with low plant cover) to establish and flourish. Historically, blowouts were generated by strong winds following reductions in vegetation cover initiated by fire, intensive ungulate grazing, and pocket gophers (*Thomomys talpoides*; Lesica and Cooper 1999). With settlement of the Centennial Valley, the agents that cause blowouts are no longer sufficient to create an abundance of large, open sand environments. The subsequent stabilization of the dunes by vegetation has reduced the open sand habitat that the rare plant and animal species need. Approaches to creating more blowouts, or at least the early successional stages required to maintain the rare species, have been outlined by Lesica and Cooper (1999) and Schassberger (1988). These include increasing the grazing pressure across the dunes, with the aim of reducing the cover of the grazing-sensitive *Festuca idahoensis* to create blowout areas.

The increase in invasive and noxious weeds in Montana poses another strong, but potential threat to the Centennial Valley Sand Dunes. Of the 50 noxious, regulated, and invasive aquatic plant species in Montana, Cheatgrass (*Bromus tectorum*) is the primary threat to the sand dunes habitat (Bosworth 2010). Cheatgrass is known to grow well in arid environments, colonize disturbed habitats, rapidly sequester moisture, and prolifically sprout from seed (Mosely et al. *in* Sheley and Petroff 1999). Where populations grow, it remains persistent and changes the fire regime and ecological processes in the area (Pellant 1990; Peters and Bunting 1994). Since at least the early 2000s, ongoing cooperative efforts between CVA members and government management agencies have prevented and controlled invasive and noxious plants, resulting in a landscape that is little impacted by weeds (Centennial Valley Sand Dune Working Group 2023). However, monitoring for and controlling of non-native plants is an on-going, continual task.

CONSERVATION GOALS & OBJECTIVES

The goal is to sustain the Centennial Valley Sand Dunes Unique Habitat of GCN, and the Plant Species of GCN, rare animal species, and rare plant associations that rely on them. Effectively conserving the Centennial Valley Sand Dunes requires a fusion of biological, academic, management, educational, and possibly economic and political approaches. Sustaining the Centennial Valley Sand Dunes Unique Habitat of GCN in Montana encompasses objectives from four areas that are pillars for plant and habitat conservation:

- Information Needs [Inventory, Monitoring, Research]
- Protection and Restoration
- Outreach and Education
- Policy and Regulation

Photo Credit: Matt Lavin

*Photo 3. Sand Wildrye (*Elymus flavescens*), a Plant Species of GCN, occurs in the Centennial Valley Sand Dunes Unique Habitat of GCN.*

Implementing any of the following conservation objectives should enhance the integrity, function, and/or longevity of the Centennial Valley Sand Dunes unique habitat and the rare plant and animal species and plant associations that rely on them. These conservation objectives were developed by members of the Strategy's Core Team with major input from land managers in the Centennial Valley representing TNC, USFWS, and MT/Dakotas BLM. They should also be used in conjunction with overarching conservation objectives that apply generally to Unique Habitats of GCN (refer to Section 5 of this *Strategy*). Working within and across jurisdictional boundaries, these conservation objectives are voluntary measures intended to empower land managers, landowners, non-governmental organization leaders, and individuals who want to work together to sustain Centennial Valley Sand Dunes across the Montana landscape.

Information Needs [Inventory, Monitoring, Research]

Conservation Goal

Improve scientific understanding of the ecological processes that form the Centennial Valley Sand Dunes and the natural history and status of associated rare plant and animals through inventory, monitoring, and research.

Conservation Objectives or Actions

1) Conduct field surveys, monitoring, and research that operate across jurisdictions and elicits information to assist in the management and/or ecological understanding of sand dune habitat and species. Identified topics include, but are not limited to:
    a. Distributional extent of dune stabilization and the locations and sizes of blowout areas.
    b. Examination of the ecological responses of plant and animal species in the sand dune system from the extensive sagebrush die-off that began in Spring 2018.
    c. Assess population counts and conduct mapping for each plant and animal species identified in this profile.
    d. Conduct field surveys, population estimates, and mapping of non-native invasive, noxious, and regulated plant species, especially in areas where weeds were previously treated or controlled.
    e. Examine the effects of grazing relative to sand dune creation and stabilization. Studies should quantify baseline conditions, test experimental methods, and quantify changes.
2) Conduct research that studies historic management practices (livestock grazing, fire management, pre-settlement vegetation (Lesica and Cooper 1997), and others) and treatments to assess their impacts on plant composition and the potential to create/retain sand dune habitat for rare species.
3) Compile past and existing monitoring and inventory protocols and generated data to analyze or summarize information relative to sand dune habitat and species management. Sources of past data collection efforts include, but are not limited to:
    a. Idaho Natural Heritage Program for tiger beetle studies and protocols (see also Bosworth et al. 2010).
    b. Monitoring data collected in 2011 by TNC and MT/Dakotas BLM.
    c. USFWS archives, including at Red Rocks NWR, for past survey and monitoring results.
    d. Data from the “Creative management strategies” conducted by USFWS and MT/Dakotas BLM, e.g., the 2017 Salt Block Pilot Study, which placed salt blocks in specific locations to attract ungulates to create ground disturbance. Data collected included surveys for rare plants and percent cover of bare ground.
    e. Past seed collection projects that may have included descriptions of vegetation.

Information Needs [Inventory, Monitoring, Research]

4) Develop a high-resolution map of the dune landscape and its plant associations, including documenting locations of rare plant and animal species and plant associations. The map could identify areas that have high potential for habitat restoration, which are places with the barest ground. The map could identify sites for implementing a high-intensity grazing system. The map could also identify the best spots for rare plant and animal species recruitment.

5) Collaborate with the MTDNRC who has a program for using drones. Drones may be useful for collecting low-elevation imagery, and re-collecting imagery at intervals to show changes in habitat.

6) Promote research to determine the historic frequency and distribution of blowout areas, with the goal of increasing the recruitment of open dune-dependent rare plant species. One such project could be to promote high-intensity, short-term grazing to mimic historic bison use of the area.

7) Expand into the dune landscape a 2022/2023 TNC study of bird responses to grazing treatments that is taking place in the adjacent shrub-steppe communities.

8) Consult the Biological Inventory of the Great Sand Dunes and San Luis Lakes publication (Pineda et al. 1999) to determine if any recommendations or information is useful for management of the Centennial Valley Sand Dunes Unique Habitat of GCN.

Protection and Restoration

Conservation Goal

Secure on-the-ground, site-specific habitat and/or management protection or restoration for the Centennial Valley Sand Dunes that also sustains populations of rare plant species, animal species, and plant associations.

Conservation Objectives or Actions

1) Convene a "local management team" with representation from the CVA, TNC, USFWS, MT/Dakotas BLM, and MTDNRC to continue coordination and develop a shared management plan that examines the ecological condition of this unique habitat. The team could also identify potential actions to sustain natural structure, composition, and function, and target areas to enhance or create blowouts and where grazing intensity could be higher.

Photo Credit: Chuck Carlson

*Photo 4. Big Sand Tiger Beetle (*Cicindela formosa *ssp.* formosa*) near Fort Peck, Montana.*

Protection and Restoration

2) Consult with the Nebraska Natural Heritage Program[14] on their projects to create blowouts and restore habitat for Blowout Penstemon (*Penstemon haydenii)*, a rare plant in Nebraska and Wyoming.

3) Review the present protection status of land parcels where rare plant and animal species occur - that have a high probability of establishing in the sand dune landscape. Develop management plants aimed to protect and/or restore these areas and to promote persistence of the species.

4) Review MT/Dakotas BLM management of national recreational trails that cross the dune landscape and assess any negative impacts to rare plant and animal species. Where negative impacts are identified, develop and implement a plan to reduce them.

5) Through coordinated efforts, test and develop studies that use livestock as disturbance vectors to create or restore blowouts (see also Information Needs Conservation Objectives 1-6).

6) Convene a meeting or working group led by Montana Native Plant Society (MNPS) members and invite various stakeholders (CVA, TNC, USFWS, MT/Dakotas BLM, and MTDNRC) to discuss the 2011 Centennial Sandhills Important Plant Area (IPA) nomination[15] and possible collaboration to create an officially recognized IPA. The goal of the Montana Native Plant Society's IPA Program[16] is to identify the most important sites for plant conservation across Montana using consistent criteria (MNPS 2023). Important sites exhibit exceptional populations of one or more globally rare plants or uncommon or threatened plant assemblages in Montana (MNPS 2023). An IPA is an informal recognition by MNPS.

Photo Credit: Peter Lesica

Photo 5. Painted Milkvetch (Astrataglus ceramicus *var.* apus*) in the Centennial Valley Sand Dunes Unique Habitat, Montana.*

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[14] Nebraska Natural Heritage Program [Botanist Gerry Steinauer]: https://outdoornebraska.gov/conservation/conservation-efforts/natural-heritage-program/

[15] MNPS Centennial Sandhills IPA nomination: https://mtnativeplants.org/wp-content/uploads/2018/07/IPA-Centennial-Sand-Hills.pdf

[16] MNPS Important Plants Areas Program: https://mtnativeplants.org/important-plant-areas/

Outreach and Education

Conservation Goal

Facilitate the stewardship of the Centennial Valley Sand Dunes and associate rare plant and animal species and plant associations through education, outreach, and coordination.

Conservation Objectives

1) Continue the good working relationships established among the CVA, TNC, USFWS, MT/Dakotas BLM, and MTDNRC to facilitate stewardship of the Centennial Valley Sand Dunes and the rare plant and animal species and plant associations found there.

2) Revise profiles on the Montana Field Guide1 for each Plant Species of GCN and other native plant species that associate with the Centennial Valley Sand Dunes Unique Habitat of GCN. Using the newest MTNHP standards will update and expand known information on the species' life history, ecology, wildlife-plant interactions, identification, taxonomy, range, habitat, biology, economics, management, threats, taxonomy, and other interesting facts; improve readability; and link to other online resources. Cross-walking plants, animals, and habitats on the Montana Field Guide will elevate awareness of this unique habitat.

3) Revise profiles on the Montana Field Guide[1] for each animal Species of Concern. Cross-walking plants, animals, and habitats on the Montana Field Guide will elevate awareness of this unique habitat.

4) Consult with educational staff at Montana Fish, Wildlife, and Parks to develop an educational unit about this unique habitat and its associated plants and animals.

5) Through TNC and the Centennial Valley Association, engage private landowner(s) in caring for natural dune habitats, and encourage their participation in the conservation planning effort. Note: The Montana Native Plant Society, through their Small Grants Program, previously funded a CVA weed management project in the Valley; they may be helpful in encouraging landowners to participate in future stewardship activities.

Photo Credit: Matt Lavin

Photo 6. Fendler Cat's-eye (Cryptantha fendleri) in Idaho

Outreach and Education

6) Work with CVA to assess the two kiosks at each end of the Valley to determine their condition and need for updated information. Public educational materials can give recreational users a sense of place, enhance their experience, and garner support for stewardship activities.
    a. Consider adding displays or brochures to the kiosks that inform visitors about this unique habitat and geology, its associated rare plant and animal species, plant associations, and stewardship activities.
    b. Evaluate the kiosks and develop recommendations on how to maintain or repair the kiosks for the short- and long-terms.
7) Work with the USFWS Red Rocks NWR staff to assess the roadside geologic interpretive kiosk to determine its condition and need to update information, including information about the biological uniqueness of the dunes and their importance to rare species conservation. Public educational materials can give recreational users a sense of place, enhance their experience, and garner support for stewardship activities.
    a. Consider adding displays or brochures to the kiosk to inform visitors about this unique habitat and geology, its associated rare plant and animal species and plant associations, and stewardship activities.
    b. Evaluate the kiosks and develop recommendations on how to maintain or repair the kiosks for the short- and long-terms.
8) Open a dialogue with Native American Tribes that undertake "usual and accustomed" activities in the dune landscape to inquire about involvement, and if appropriate to understand how best to steward these areas educate the public about their cultural significance.

Policy and Regulation

Conservation Goal

In cooperation with public land managers, private landowners, and other interested stakeholders, support policies and regulations that aim to conserve the Centennial Valley Sand Dunes and its associated species and plant associations.

Conservation Objectives

1) Through collaboration with CVA, TNC, USFWS, MT/Dakotas BLM, MTDNRC, Montana Native Plant Society (MNPS), and/or other interested landowners, identify and nominate (a) parcel(s) of Centennial Valley Sand Dune habitat to the board of land commissioners [MCA 79-12-104(1)] for possible designation as a Montana Natural Area.
2) For federal and state staff, review federal (USFWS, BLM) and state (DNRC) agencies' policies and land management plans - with TNC to determine whether special protection measures could be applicable, are being implemented, and/or need amending for the Centennial Valley Sand Dunes landscape.

REFERENCES

Bosworth, William R.; Suzin J. Romin; and Tim Weekley. 2010. *Bruneau Dunes Tiger Beetle Assessment*. - Boise, ID: Idaho Department of Fish and Game.

Montana Native Plant Conservation Strategy-Centennial Valley Sand Dune Working Group. 2023. Meetings, document review, and electronic mail correspondences. January 18, 2023 to March 2024. Information available from Andrea Pipp, Montana Natural Heritage Program, Helena, MT.

Federal Register. 2016. "Endangered and Threatened Wildlife and Plants; 90-Day Findings on 29 Petitions." 81:51 (March 16, 2016). - Department of the Interior, Fish and Wildlife Service, Washington D.C. p 14071. https://www.govinfo.gov/content/pkg/FR-2016-03-16/pdf/2016-05699.pdf

Lesica, Peter, and Stephen V. Cooper. 1997. "Presettlement vegetation of Southern Beaverhead County, Montana". Prepared for USDI Bureau of Land Management State Office, Billings, MT and USDA Forest Service, Beaverhead-Deerlodge National Forest, Dillon, MT. Prepared by Montana Natural Heritage Program, Helena, MT.

Lesica, Peter, and Stephen V. Cooper. 1999. "Succession and disturbance in sandhills vegetation: constructing models for managing biological diversity." *Conservation Biology* - 13-(2): 293-302.

Hendricks, Paul, and Peter Lesica. 2007. "A disjunct population of *Cicindela formosa* Say in southwestern Montana, U.S.A. (*Coleoptera: Cicindelidae*)." Cicindela 39: 53-8.

Hendricks, Paul, and Michael Roedel. 2002. "Preble's Shrew and Great Basin Pocket Mouse from the Centennial Valley Sandhills of Montana." *Northwestern Naturalist* 83,(1): 31-4.

Montana Native Plant Society (MNPS). 2024. Important Plant Areas. Missoula, MT. - https://mtnativeplants.org/important-plant-areas/ [Accessed 19 February 2024]

Montana Natural Heritage Program (MTNHP). 2022. Information from the MTNHP plant and animal observation database. May and June. MTNHP, Helena, MT.

Montana Natural Heritage Program (MTNHP). 2024a. Painted Milkvetch (*Astragalus ceramicus* var. *apus*) field guide profile. MTNHP, Helena, MT-https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PDFAB0F1V1 [Accessed 16 February 2024]

Montana Natural Heritage Program (MTNHP). 2024b. Sand Wildrye (*Elymus flavescens*) field guide profile. MTNHP, Helena, MT. https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PMPOA6P080 [Accessed 16 February 2024]

Montana Natural Heritage Program (MTNHP). 2024c. Fendler Cat's-eye (*Cryptantha fendleri*) field guide profile. MTNHP, Helena, MT. https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PDBOR0A0X0 [Accessed 16 February 2024]

Montana Natural Heritage Program (MTNHP). 2024d. Columbia Plateau Pocket Mouse (*Perognathus parvus*) field guide profile. MTNHP, Helena, MT. https://fieldguide.mt.gov/speciesDetail.aspx?elcode=AMAFD01100 [Accessed 16 February 2024]

Montana Natural Heritage Program (MTNHP). 2024e. Big Sand Tiger Beetle (*Cicindela formosa*) field guide profile. MTNHP, Helena, MT https://fieldguide.mt.gov/speciesDetail.aspx?elcode=IICOL02040 [Accessed 16 February 2024]

Montana Natural Heritage Program (MTNHP). 2024f. Saint Anthony Dune Tiger Beetle (*C. arenicola*) field guide profile. MTNHP, Helena, MT. https://fieldguide.mt.gov/speciesDetail.aspx?elcode=IICOL02130 [Accessed 16 February 2024]

Montana Natural Heritage Program (MTNHP). 2024g. Western Bumble Bee (*Bombus occidentalis*) field guide profile. MTNHP, Helena, MT. https://fieldguide.mt.gov/speciesDetail.aspx?elcode=IIHYM24252 [Accessed 16 February 2024]

Mosley, Jeffrey C. et al. 1999 "Cheatgrass." In Biology and Management of Noxious Rangeland Weeds., Roger J. Sheley and Janet K Petroff. - Corvallis, OR: Oregon State University Press -.

NatureServe Explorer. 2024a. Global Conservation Status Factors and Rank for *Bombus occidentalis*. Evaluated April 18, 2018. https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.916920/Bombus_occidentalis [Accessed 16 February 2024]

NatureServe Explorer. 2024b. *Artemisia tridentata* spp. *tridentata / Hesperostipa comata* Shrubland. https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.689792/Artemisia_tridentata_ssp_tridentata_-_Hesperostipa_comata_Shrubland [Accessed 16 February 2024]

NatureServe Explorer. 2024c. *Elymus lanceolatus - Phacelia hastata* Grassland profile. https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.684114/Elymus_lanceolatus_-_Phacelia_hastata_Grassland [Accessed 16 February 2024]

Pellant, Mike. 1990. "The cheatgrass-wildfire cycle - are there any solutions?" In Proc. Symp. on cheatgrass invasion, shrub die-off, and other aspects of shrub biology and management, edited by E.D. McArthur, E. M Romney, S.D. Smith, and P.T. Tueller. 11-18.USDA For. Ser. Gen. Tech. Rep. INT-276.

Peters, Erin F., and Stephen C. Bunting. 1994. "Fire Conditions pre- and post-occurrence of annual grasses on the Snake River Plain." In Proc. Ecology and management of annual rangelands, edited by Stephen B. Monsen and Stanley G. Kitchen, 31-36. USDA For. Ser. Gen. Tech. Rep. INT-GRR-313.

Pineda, Phyllis, Renee Rondeau, and Anne Ochs. 1999. "A Biological Inventory and Conservation Recommendations for the Great Sand Dunes and San Luis Lakes, Colorado". March. Prepared for The Nature Conservancy, San Luis Valley Program, Saguache, Colorado. Prepared by Colorado Natural Heritage Program, Colorado State University, College of Natural Resources, Fort Collins, CO.

Schassberger, Lisa A. 1988. "Effects of Grazing on the Habitat of *Astragalus ceramicus* var. *apus* in the Sandhills of the Centennial Valley, Montana." (master's thesis, University of Montana),-84 pp.

US Department of the Interior, Bureau of Land Management (USDI-BLM). 2006. Record of Decision and Approved Dillon Resources Management Plan. https://eplanning.blm.gov/eplanning-ui/project/77497/570

U.S. Fish and Wildlife Service (USFWS). 2023. Status information for the Western Bumble Bee (*Bombus occidentalis*). https://www.fws.gov/species-publication-action/90-day-findings-29-petitions-notice-petition-findings-and-initiation-6 [Accessed 16 February 2024]

Wikipedia. 2024. Searches for sand dune and sand hill definitions. March 18. https://en.wikipedia.org/wiki/Sandhill and https://en.wikipedia.org/wiki/Dune

CONSERVATION PROFILE:
METAMORPHOSED LIMESTONE

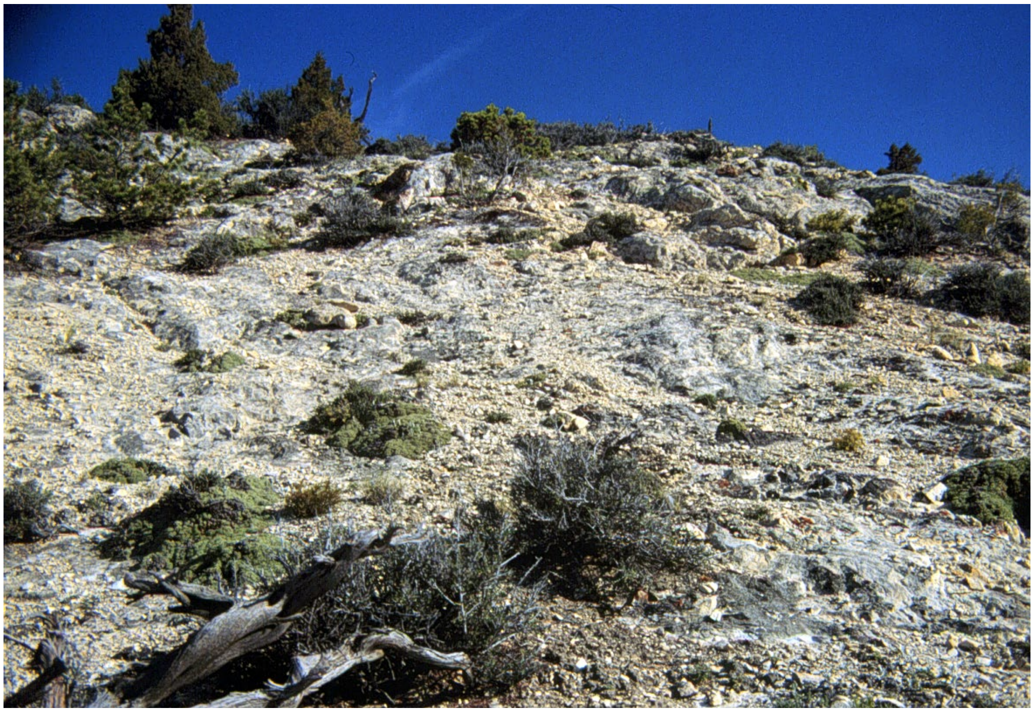

Photo Credit: Steve Shelly, MTNHP

Photo 1. A metamorphosed limestone outcrop in the Birch Creek drainage of the Pioneer Mountains in Montana.

PURPOSE:

This conservation profile provides information about the Metamorphosed Limestone Unique Habitat of Greatest Conservation Need (GCN) in Montana. It highlights their formation; state distribution; ecological values to rare plants; factors that influence this habitat's vulnerability to persistence; and voluntary conservation objectives, that, if continued or implemented, would aid its persistence in Montana. The conservation profile aims to be a brief, stand-alone document that can be used by or shared with land managers, landowners, educators, decision-makers, regulators, and anyone interested in this unique habitat. This conservation profile should also be used in conjunction with Section 5 of the Montana Native Plant Conservation Strategy which addresses overarching conservation objectives for Unique Habitats of GCN.

INFORMATION ON METAMORPHOSED LIMESTONE UNIQUE HABITAT

Description and Formation

On the margins of some mountain ranges in southwest Montana there are outcroppings of calcareous soils that developed from layers of limestone that were metamorphosed (heated) when the adjacent mountains intruded through those overlying layers (Lesica and Shelly 1992) (Photo 1). The associated substrates are typically light in color and have a thin soil that covers the bedrock or has a gravelly loam surface. In many cases the sites are very sparsely vegetated because they have harsh ecological conditions. The areal extent of these outcrops range from few to several hundred acres. The outcrops are typically visible from adjacent roads or trails due to their distinctive coloration and sparse vegetative cover.

Locations in Montana

Metamorphosed limestone habitat is found in the Sapphire, Pioneer, and Highland Mountains in southwest Montana. In the Sapphire Mountains of Ravalli County, the outcrops occur on the lower western slopes. In Beaverhead County, the outcrops occur in drainages (such as in Birch Creek, Cattle Gulch, and Canyon Creek) on the east and north margins on the eastern side of the Pioneer Mountains. In the Highland Mountains of Silver Bow County, the outcrops occur in the drainages (such as Moose Creek) that are east of Divide, Montana.

Unique Ecology and Biological Distinctions

The Metamorphosed Limestone Unique Habitat has unusual soil conditions. The soils are predominantly calcareous sandy loams, or silty loams, derived from outcrops of metamorphosed calc-silicates or limestone (Lesica 1992; Lesica and Shelly 1994). These soils have a tendency to slump on moderate to steep slopes (Lesica and Shelly 1994). The conditions and properties of these soils have influenced the flora on the landscape (edaphic). As a result, the Metamorphosed Limestone Unique Habitat is distinct from adjacent habitats in a given area.

Areas of Metamorphosed Limestone have become important habitats for specific native plant species and plant communities. Sapphire Rockcress (*Boechera fecunda*) is known only to occur in Montana (State endemic) where its distribution is restricted to the metamorphosed limestone habitats (MTNHP 2024a) (Photo 2; refer to conservation profile in Appendix A). An uncommon plant community found on this substrate is Mountain Mahogany / Bluebunch Wheatgrass (*Cercocarpus ledifolius / Elymus (Agropyron) spicatum*). An outstanding example of this plant community occurs in the Cattle Gulch Research Natural Area (RNA) on the Beaverhead-Deerlodge National Forest.

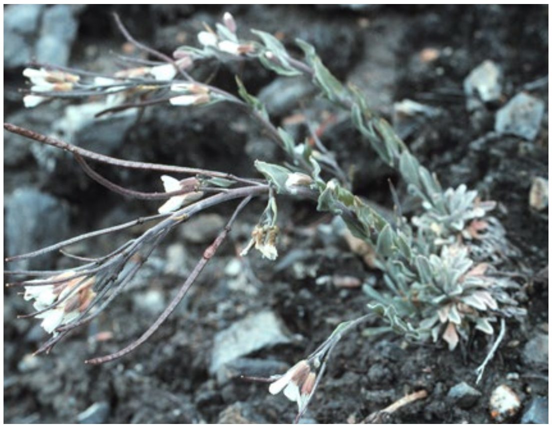

Photo Credit: Peter Lesica.

Photo 2. Sapphire Rockcress (Boechera fecunda), *a Plant Species of GCN, only grows in the Metamorphosed Limestone Unique Habitat.*

Learn about Sapphire Rockcress plant identification, biology, and status in the Montana Field Guide.[1]

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[1] Montana Field Guide (MTNHP 2024a): https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PDBRA06290

RATIONALE FOR UNIQUE HABITAT OF GREATEST CONSERVATION NEED

Areas occupied by metamorphosed limestone are designated as a Unique Habitat of Greatest Conservation Need (GCN) in Montana because they formed from unusual conditions, occur across small areas, support rare flora, and face threats that put their persistence into question. On a global scale, Sapphire Rockcress is only found in Montana, and specifically only on metamorphosed limestone habitats. Sapphire Rockcress exemplifies one of Montana's best examples for an edaphic, endemic plant species. The Mountain Mahogany / Bluebunch Wheatgrass is also an uncommon plant community for Montana.

These areas of metamorphosed limestone are facing anthropogenic threats that make the habitat vulnerable to extirpation in Montana. The most imminent threat to these outcrop habitats is invasion from non-native plants, especially in localized places where there is deeper soil development. The outcrops in Ravalli County, which have loamier soils, have the worst infestations of Spotted Knapweed (*Centaurea stoebe)* (Lesica and Shelly 1996). In Beaverhead County, Spotted Knapweed and other non-native plant species are colonizing the lower slopes and access route into the Cattle Gulch RNA. Spotted Knapweed can out-compete native plant species (MTNHP 2024b) while the non-native Cheatgrass (*Bromus tectorum*) has the ability to change a site's ecology (MTNHP 2024c). Other threats identified as occurring in areas of metamorphosed limestone include recreation and incompatible livestock grazing. Recreation and incompatible livestock grazing have been regarded as minor threats.

Photo Credit: Scott Mincemoyer

Photo 3. Mountain Mahogany (Cercocarpus ledifolius) *is often dominant in the Metamorphosed Limestone Unique Habitat. Dillon Field Office, MT/Dakotas BLM.*

CONSERVATION GOALS & OBJECTIVES

The goal is to sustain the Metamorphosed Limestone Unique Habitat of GCN and the Plant Species of GCN and uncommon plant communities that rely on them. Effectively conserving the Metamorphosed Limestone unique habitat requires a fusion of biological, academic, management, educational, and possibly economic and political approaches. Sustaining the Metamorphosed Limestone Unique Habitat of GCN in Montana encompasses objectives from four areas that are pillars for plant and habitat conservation:

- Information Needs [Inventory, Monitoring, Research]
- Protection and Restoration
- Outreach and Education
- Policy and Regulation

Implementing any of the following conservation objectives should enhance the integrity, function, and/or longevity of the Metamorphosed Limestone unique habitat and the rare plant and communities that rely on them. These conservation objectives were developed by a working group with major input from botanists, an ecologist, and a rangeland management specialist working for the US Forest Service-Region 1, Beaverhead-Deerlodge National Forest (BDNF), Montana/Dakotas Bureau of Land Management (MT/Dakotas BLM), and MT/Dakotas BLM Dillon Field Office. The conservation objectives should also be used in conjunction with overarching objectives that apply generally to Unique Habitats of GCN (refer to Section 5 of this *Strategy*). Working within and across jurisdictional boundaries, these conservation objectives are voluntary and intended to empower land managers, landowners, non-governmental organization leaders, and individuals who want to work together to sustain the Metamorphosed Limestone unique habitat in Montana.

Photo Credit: Andrea Pipp

Photo 4. The outcrops of the Metamorphosed Limestone Unique Habitat are noticeable on the landscape from afar. Beaverhead-Deerlodge National Forest.

Information Needs [Inventory, Monitoring, Research]

Conservation Goal

Improve scientific understanding of metamorphosed limestone outcrops in southwestern Montana and the natural history and status of associated rare plants and communities through inventory, monitoring, and research.

Conservation Objectives

1) Develop a state-wide data layer for Metamorphosed Limestone Unique Habitat sites. This would involve field data collection efforts, using ESRI Arc-GIS software, Montana State Library (MSL) state data layers, and other tools. Components include, but are not limited to:
   a. Compiling digitized data, reports, and mapping from the MSL-MTNHP and BDNF archives.
   b. Delineate ecological- and geological-based boundaries for each site.
   c. Conduct field visits to verify habitat (ecological and geological signatures) and targeted plant species and plant associations.

2) After developing a state-wide data layer for Metamorphosed Limestone Unique Habitat sites, determine if a predictive habitat model could be developed. Determine the parameters and attributes. Ground-truth sites that are identified as potential habitat. For example, the Cold Springs/Grasshopper Creek area in Beaverhead County may have additional locations.

3) After developing a state-wide data layer for Metamorphosed Limestone Unique Habitat sites, overlay the unique habitat layer with the MTNHP rare plant, rare animal, Ecological Systems, and National Vegetation Classification Systems (NCVS) data layers to determine if other components of rarity overlap.

4) Conduct inventories for additional locations of metamorphosed limestone habitat. For example, the Cold Springs/Grasshopper Creek area in Beaverhead County may have additional locations.

5) For established plots on the Beaverhead-Deerlodge National Forest, continue to collect trend and demographic monitoring data for *Boechera fecunda* populations, analyze data, and report findings (see Section 4 and Sapphire Rockcress Conservation Strategy, Appendix A).

6) Develop a monitoring protocol to track the ecological health and condition of Metamorphosed Limestone Unique Habitat sites across its state range. Threats from invasive weeds, recreational use and livestock grazing should be evaluated.

7) Where 'advanced succession'[2] is occurring in the habitat, develop a management goal, study or monitoring plan, and analysis plan to evaluate and address conifers.

8) Conduct an assessment where any subsequent conifer reduction projects have taken place within or adjacent to Metamorphosed Limestone Unique Habitat sites. Examples: Removing Douglas-fir trees through manual control in Cattle Gulch RNA and Birch Creek.

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[2] In the absence of disturbance, vegetation succession naturally occurs. A more accurate ecological term to use is 'advancing succession', which removes any judgements that may come with the use of 'conifer encroachment'.

Protection and Restoration

Conservation Goal

Secure on-the-ground, site specific habitat, and/or management protection or restoration for Metamorphosed Limestone Unique Habitat areas that also sustain populations of associated rare plant species and communities.

Conservation Objectives

1) Assess the suitability of known sites for possible designation as a Research Natural Area (RNA), Botanical Special Area, Area of Critical Environmental Concern (ACEC), MNPS Important Plant Area (IPA), or other conservation target.
2) Determine if any Metamorphosed Limestone Unique Habitat sites are currently included in any conservation easements.
3) Open a dialogue with various land trusts to evaluate if any Metamorphosed Limestone Unique Habitat sites could be included in conservation easements.
4) Where advanced succession is determined to be a threat to Metamorphosed Limestone Unique Habitat sites, develop a management plan and tactics to remove conifers.
5) Where sites are being invaded or encroached upon by invasive non-native plants, implement an integrated weed management plan. As appropriate, work in coordination with county weed districts and private landowners.

Outreach and Education

Conservation Goal

Facilitate the stewardship of metamorphosed limestone habitats and associated rare plant species and communities through education, outreach, and coordination.

Conservation Objectives

1) On the MTNHP Montana Field Guide for Sapphire Rockcress, revise the habitat and/or range sections to address the Metamorphosed Limestone Unique Habitat of GCN.
2) Consult with educational staff at Montana Fish, Wildlife and Parks or Montana Native Plant Society to develop an educational unit on the Metamorphosed Limestone Unique Habitat. Develop outreach materials in coordination with the Montana Native Plant Society.
3) Consider using Citizen Botanists from the MNPS-MTNHP Citizen Botany Program to assist in field inventories and monitoring.
4) Find opportunities to broaden education and awareness of the Metamorphosed Limestone Unique Habitat of GCN within the land management agencies and with the public.

Outreach and Education

5) Evaluate the interpretive sign at Vipond Park[3] to determine its condition and need to update or expand information. If warranted, develop recommendations on how to repair and/or maintain the sign for the short- and long-term.

Policy and Regulation

Conservation Goal

In cooperation with public land managers, private landowners, and other interested stakeholders, support policies and regulations that aim to conserve metamorphosed limestone habitat and associated plant species and plant associations.

Conservation Objectives

1) Both the BDNF and the MT/Dakotas BLM Dillon Field Office have land management plans containing policies that protect rare plants and their habitats. These plans should be consulted for specific conservation measures that pertain to metamorphosed limestone and other habitats of conservation concern:
    a) Beaverhead-Deerlodge NF – Forest Plan[4]: The pertinent sections in this plan include direction for sensitive plant and unique habitat conservation in the Vegetation section of Chapter 3.
    b) BLM Dillon Resource Area – Plan[5]: The pertinent sections in this plan include Special Status Plants; Noxious Weeds, Invasive and Non-Native Species; and Travel Management and OHV Use.
2) Finalize the establishment of the Cattle Gulch RNA on the Beaverhead-Deerlodge NF.
3) Work with state agencies to identify potential conservation opportunities under the Montana Natural Areas Act of 1974.

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[3] Vipond Park: https://www.fs.usda.gov/wildflowers/regions/northern/VipondPark/index.shtml

[4] USFS, Beaverhead Deerlodge NF: Beaverhead-Deerlodge National Forest - Planning (usda.gov)

[5] BLM Dillon Field Office: https://eplanning.blm.gov/public_projects/lup/77497/103609/126835/ApprovedPlan.pdf

REFERENCES

Montana Natural Heritage Program (MTNHP). 2024. Sapphire Rockcress (*Boechera fecunda*) field guide profile. MTNHP, Helena, MT. https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PDBRA06290 [Accessed 16 March 2024]

Montana Natural Heritage Program (MTNHP). 2024. Spotted Knapweed (*Centaurea maculosa*) field guide profile. MTNHP, Helena, MT. https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PDAST1Y140 [Accessed 16 March 2024]

Montana Natural Heritage Program (MTNHP). 2024. Sapphire Rockcress (*Bromus tectorum*) field guide profile. MTNHP, Helena, MT. https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PMPOA151H0 [Accessed 16 March 2024]

Lesica, Peter. 1992. The occurrence of *Arabis fecunda* on BLM lands in the Humbug Spires area, Silver Bow County. Unpublished report to the BLM. Montana Natural Heritage Program. Helena, Montana. 6 pp.

Lesica, Peter, and J. Stephen Shelly. 1992. Effects of cryptogamic soil crust on the population dynamics of *Arabis fecunda* (Brassicaceae). American Midland Naturalist 128: 53-60.

Lesica, Peter, and J. Stephen Shelly. 1994. Demography and life history of *Arabis fecunda* in Ravalli and Beaverhead counties, Montana. Unpublished report to the Beaverhead-Deerlodge National Forest. Montana Natural Heritage Program, Helena, MT. 29 pp.

Lesica, Peter, and J. Stephen. Shelly. 1996. Competitive effects of Centaurea maculosa on the population dynamics of *Arabis fecunda*. Bulletin of the Torrey Botanical Club 123(2):111-121.

APPENDIX C

Conservation Profile for Plant Community of GCN

CONSERVATION PROFILE:
QUAKING ASPEN (*POPULUS TREMULOIDES*) COMMUNITIES

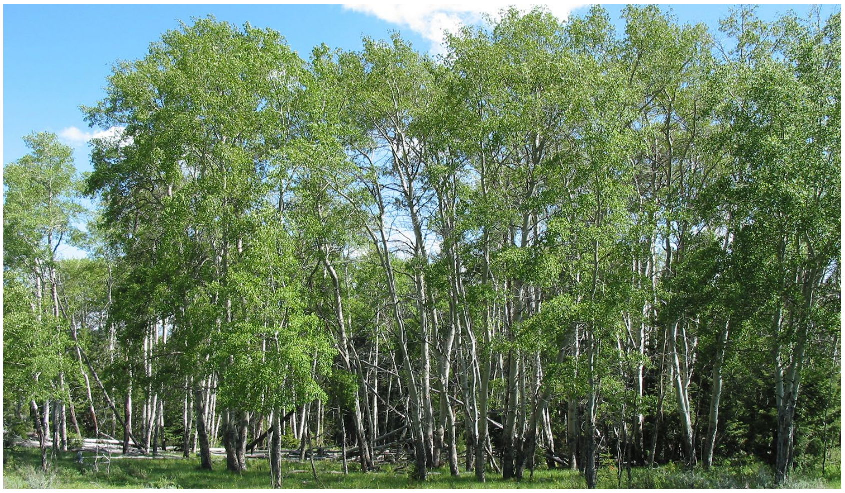
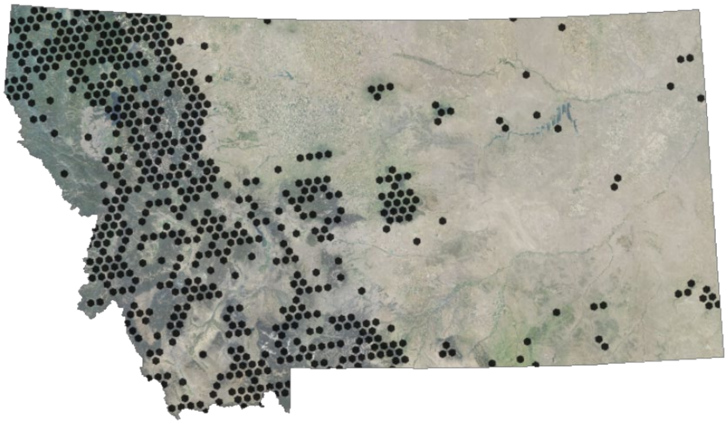


Photo credit Scott Mincemoyer

Photo 1. A Quaking Aspen Community in Montana.



Source: Montana Natural Heritage Program (2023a)

Figure 1. The distribution of Quaking Aspen in Montana based on observation data (black circles).

PURPOSE:

This conservation profile provides newer and established information about Quaking Aspen communities - a Plant Community of Greatest Conservation Need (GCN) in Montana. It addresses their state-level distribution; ecological, economic, and aesthetic values; factors that influence their vulnerability to persistence; and voluntary conservation objectives that address wildland and urban environments in Montana. These conservation objectives address the system that sustains Quaking Aspen communities and the biodiversity they support. The conservation profile aims to be an abbreviated, stand-alone document that can be used by, or shared with, land managers, landowners, educators, decision-makers, regulators, and anyone interested in Quaking Aspen conservation at the plant community level. The conservation profile also provides readers with links to the best available resources for management and aims to facilitate collaboration across Montana. This conservation profile should also be used in conjunction with Section 6 of the Montana Native Plant Conservation Strategy which addresses overarching conservation objectives for Plant Communities of GCN.

INFORMATION ON QUAKING ASPEN COMMUNITIES

Species, Distribution & Identification

Quaking Aspen (*Populus tremuloides*) is North America's most widely distributed native, deciduous tree species (Photo 1) (Eckenwalder in Flora of North America [FNA] 2010; Burns et al. 1990). Within its North American range, Quaking Aspen are native to Montana and found in most counties (Figure 1) (Lesica et al. 2022; Montana Natural Heritage Program [MTNHP] 2023a).

An individual Quaking Aspen clone is defined by its below ground root mass. A single Quaking Aspen tree, or stem, reproduces through its root system[1], by sending up shoots which are genetically identical clones of the parent tree. The below ground root crown which supports multiple stems represents the main organism. Although the aspen clone shares a single root system, the ages of the individual trees can vary, from new shoots to old trees that typically live for 80-150 years.

Learn about Quaking Aspen species' identification, biology, and status in the Montana Field Guide[2]

Community Ecology

Collectively, the clonal trees (or stems) become a community that can be found in a variety of habitats, from relatively dry environments to wetter places, on slopes ranging from gentle to steep, and in a diversity of soil types within the plains, valley, and lower subalpine zones of Montana (Lesica 2022; Rogers 2017; Mueggler 1988). What lies below these different habitats and soil types, is subterranean moisture for which the Quaking Aspen clone can capture and bring to the surface (Mueggler 1988; Rogers 2017). In addition, the clone influences the availability of moisture from rain and snow. Throughout the growing season, the "quaking" leaves dapple the environment between light and shade, reducing evaporation, and altering humidity. Come fall, stems drop their leaves, and in winter the clone traps snowfall and protects the soil from wind erosion (Chang 2006; Hiemstra, et al. 2006). Trapping snowfall helps slow snowmelt and makes moisture available into late spring. The surface moisture then drives the establishment of an understory that is typically rich in grasses, forbs, shrubs, and even other trees (Rogers 2017). Over a longer timeframe, the relatively high biomass and diversity of understory plants, coupled with the clonal habit, develops richer (organic) soils, and retains higher levels of soil moisture (Gifford et al. 1984; LaMalfa and Ryle [sic] 2008), deepens infiltration rates, helping to extend the availability of water into the growing season (Rogers 2017). These unique attributes of being both clonal and able to find subterranean moisture set Quaking Aspen apart from neighboring forest communities.

Keystone Role

The richness of plant life that develops in a Quaking Aspen community supports a diversity of wildlife, making this tree a "keystone species" (Campbell and Bartos 2001). Quantitative studies in northeastern California found that aspen stands support more plant species and a greater number of unique plant species when compared to adjacent meadows and conifer communities (Kuhn et al. 2011). Quaking Aspen trees and their understory of plants provide animals with forage and shelter, especially shade and cover for nesting and resting. Within the Quaking Aspen community, countless microhabitats develop where a diversity of insect species undergo their life cycles. In turn, numerous bird and bat species are attracted to these assemblages of insects for the rich food resources they provide (Earnst et al. 2012). The leaves and young shoots of Quaking Aspen trees also provide important year-round food for cattle, sheep, horses, elk, moose, deer, beaver, small mammals, a diversity of birds, and others (Sallabanks 2001; DeByle et al. 1985) (Photo 2). Protein-rich aspen buds, small twigs, and bark are heavily used by mammals and birds especially during the critical winter months when other foods are typically scarce. Finally, aspen communities not only support a rich diversity of organisms and natural processes within their borders, but they also help maintain the abundance of many other plant and animal species in neighboring areas.

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[1] Reproduction by seed can occur, but germination and seedling survival rates are extremely low, especially in the western US (USDA FS 2024): https://www.fs.usda.gov/wildflowers/beauty/aspen/grow.shtml

[2] Montana Field Guide (MTNHP 2023b): https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PDSAL010B0

Photo credit Paul C. Rogers

Photo 2. Thin bark is easily penetrated by herbivores, insects, and pathogens. Subsequent excavation makes for excellent cavity-nesting bird habitat.

Learn more about Quaking Aspen ecology and research from the Western Aspen Alliance[3]

Utility in Urban Environments

Given Quaking Aspen's extensive distribution across North America, and ability to establish in diverse habitats, soil types, and elevational ranges, they are a preferred species used by city, state, and federal land management agencies, as well as by citizens for multiple purposes. In fire management, Quaking Aspen communities are being studied for their ability to influence fire occurrence, behavior, and severity (Nesbit et al 2023; Alexander and Lanoville 2004; Jones and DeByle 1985; Fechner and Barrows 1976).

In general, naturally occurring Quaking Aspen communities may serve as fire breaks and buffers that can reduce harmful impacts to infrastructure from wildfires, especially where urban areas interface with wildlands [wildland-urban interface] (Nesbit et al 2023). Where adequate space is available, Quaking Aspen (and its evolving understory community) are planted as buffers to sequester and reduce pollutants and contaminants in stormwater runoff (American Society of Landscape Architects 2023; Pipp 2023). In several locations in Montana and Canada, Quaking Aspen communities have naturally colonized contaminated soils in the vicinity of functioning and defunct smelter sites (Cripps 2003). Research has discovered that their relationship with specific mycorrhizal fungi allows Quaking Aspen to increase the uptake of phosphorus and to ameliorate soil conditions of low (acidic) pH, high heavy metals, low fertility, and low moisture (Cripps 2003). When planted in appropriate settings, Quaking Aspen trees create shade, visual screens, wind blocks, and beautiful landscaped yards (Urban Forestry Outreach and Research Nursery and Lab 2023).

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[3] Western Aspen Alliance: https://qcnr.usu.edu/western-aspen-alliance/

However, there are many inappropriate places in urban areas where Quaking Aspen trees should not be planted. Their clonal nature to develop into a plant community means that they require natural settings where there is amble vertical and horizontal space for growth. Planted trees in urban places can be damaged by lawn mowers, yard tools, and urban wildlife, reducing their resiliency to certain insect and fungal species and other pathogens. Stems or roots that are damaged or dying can become hazardous trees in urban places. Damage also invokes the tree's response to produce more sprouts (also called suckers), which often is not what landowners in residential areas desire. In their role as a keystone species, Quaking Aspens create the community for which many animals, plants, and fungi rely upon, including insects and pathogens which many landowners find unsettling. To avoid unnecessary costs and wasted efforts, it is not recommended to plant Quaking Aspen trees in boulevards, urban residential areas, and other similar settings that have limited vertical and horizontal space for growth.

Quaking Aspen Community Types in Montana

Quaking Aspen plant communities are referred to by many names including clonal aspen groves, aspen parklands, aspen stands, aspen-dominated woodlands, and aspen forests (MTNHP 2023c; Eckenwalder in Flora of North America 2010; Mueggler 1988) (Photo 3). Ecologists and foresters have studied and classified numerous aspen community types and plant associations using various methods (Mueggler 1988; Rogers et al. 2014; USNVC 2023). Methods to name, map, and define the differences that people observe in Quaking Aspen stands or communities and how they respond to specific land management actions continue to evolve. A recent classification identifies aspen types based on their ecological functions which appropriately matches the type with the management action that is intended to emulate the ecosystem processes (Rogers 2017; see Box 1). For the remainder of this profile, the term "communities" is used generically except where it is defined or referenced in the sentence. Using the term "communities" acknowledges that there are many types of Quaking Aspen communities, without getting

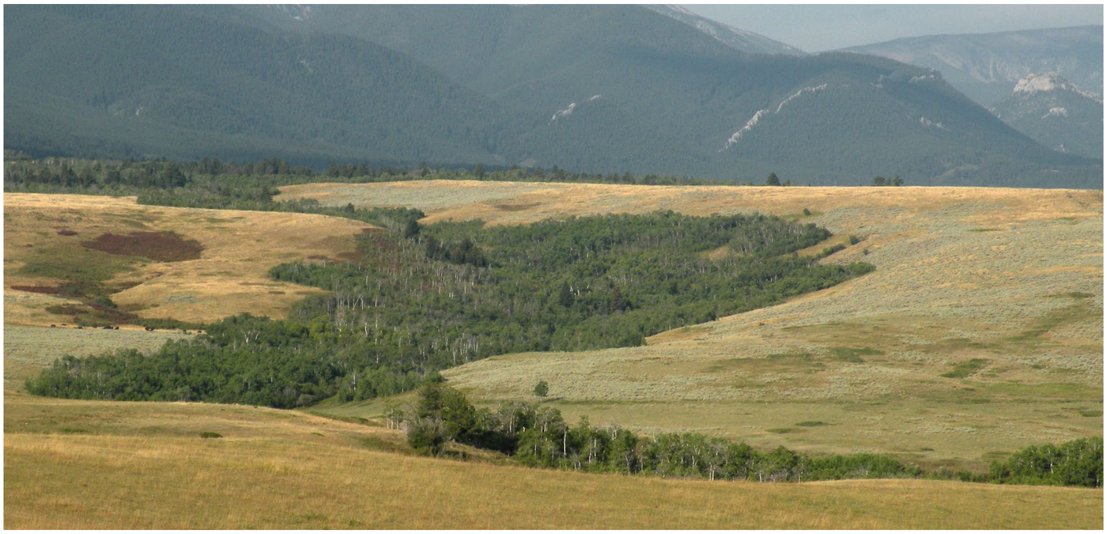
Photo credit Paul C. Rogers

Photo 3. A stable Quaking Aspen Community (center) persists in the foothills and small, seral aspen communities occur on the coniferous slopes (background) of the Absaroka Mountains near Red Lodge. Each community is a different functional type and relies on separate mechanisms for persistence.

bogged down with specific anthropogenic terms, types, or methods.

Ecologists working for the Montana Natural Heritage Program use the Ecological Systems classification (NatureServe 2003) to understand the general composition, distribution, and condition of biological communities in Montana. An Ecological System represents a biological community that re-occurs across the landscape in similar physical environments and is influenced by similar (yet dynamic) ecological processes, such as fire or flooding (MTNHP 2023c). An Ecological System is mappable and tends to be intuitive to non-ecologists. In contrast to Ecological Systems, the U.S. National Vegetation Classification (USNVC) emphasizes taxonomic groupings of existing vegetation across the natural-cultural continuum in the United States (USNVC 2023). To be of greater utility to ecologists and other professional scientists, Montana's Ecological Systems were cross-walked in 2017 to one or more USNVC Groups and appear on the Montana Ecological Systems Field Guide[4,5] (Vance et al. 2017a and 2017b; MTNHP 2023c). In Montana, two aspen related Ecological Systems have been named and defined:

Aspen Forest and Woodland Ecological System

The *Aspen Forest and Woodland Ecological System* was classified and mapped using the 2017 Montana Land Cover layers (Vance et al. 2017a). A portion of this aspen community type comprises the southernmost extension of the much larger Canadian "aspen parkland" (Rogers et al. 2014). This long-lived clonal system is dominated by Quaking Aspen and has less than a 25% conifer presence. From a functional ecology perspective, these aspen communities are defined as "stable aspen" which perpetuate for multiple stand generations without stand-replacing disturbance (Harness and Harper 1982; Rogers et al. 2014; Shinneman et al. 2013). Rather, these systems are maintained predominantly by small-scale disturbances such as browsing, windstorms, insects, disease, and beaver activity. These stands persist through individual stem and small group replacement. Thus, such communities are characterized by single tree-species dominance, but with complex multi-age vertical stand structure. The telltale symptoms of declining stable aspen forests include prominent signs of browsing and a simple, single-layer stand structure; thereby, a loss of the native plant community and increase in stem mortality. In this Montana Plant community, excessive ungulate (domestic or wild) herbivory in the *Aspen Forest and Woodland Ecological System* may cause loss of the entire clone itself.

The *Aspen Forest and Woodland Ecological System* has a Montana Provisional State Rank of S3, indicating that it is potentially at risk because of limited and/or declining range and/or habitat, even though it may be abundant in some areas (Vance et al. 2017a). This Ecological System crosswalks with four USNVC Groups (Vance et al. 2017a):

- G216 Black Hills-Northwestern Great Plains Ponderosa Pine Forest & Woodland
- G218 Rocky Mountain Subalpine Moist Spruce-Fir Forest & Woodland
- G222 Rocky Mountain Subalpine-Montane Aspen Forest & Woodland
- G506 Rocky Mountain-Great Basin Montane Riparian & Swamp Forest

Learn more about Aspen Forest and Woodland Ecological System in the Montana Field Guide[4].

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[4] Montana Ecological Systems Field Guide: https://fieldguide.mt.gov/displayES_Detail.aspx?ES=4104

Aspen and Mixed Conifer Forest Ecological System

The *Aspen and Mixed Conifer Forest Ecological System* was classified and mapped using the 2017 Montana Land Cover layers (Vance et al. 2017b). The *Aspen and Mixed Conifer Forest Ecological System* parallels Rogers et al. (2014) "seral montane" functional type. This system is found primarily on gentle to steep slopes in the Big Snowy Range in north-central Montana and has more than a 25% conifer dominance. This system is in decline and requires periodic stand-replacing disturbances such as fire, windstorms, avalanches, or floods to rejuvenate aspen stems. Due to the exclusion of fire, as well as a generally wet 20th century climate pattern, advancing succession of the vegetation is leading to a greater cover of conifers and declines in aspen and dependent plant communities (Rogers et al. 2011). Where excessive herbivory by domestic and/or wild ungulates follows disturbance, the heavy browsing will prevent clones from recovering resulting in acute declines of Quaking Aspen trees.

The *Aspen and Mixed Conifer Forest Ecological System* has a Montana Provisional State Rank of S3/S4, indicating it is "potentially at risk to apparently secure, though it might be limited, declining, or quite rare in parts of its range, and/or suspected to be declining (Vance et al. 2017b)". This Ecological System crosswalks with six USNVC Groups (Vance et al. 2017b):

- G228 Southern Rocky Mountain Ponderosa Pine Forest & Woodland
- G226 Southern Rocky Mountain White Fir-Douglas Fir Dry Forest
- G215 Middle Rocky Mountain Montane Douglas Fir Forest & Woodland
- G218 Rocky Mountain Subalpine Moist Spruce-Fir Forest & Woodland
- G221 Rocky Mountain Subalpine-Montane Limber Pine-Bristlecone Pine Woodland
- G506 Rocky Mountain-Great Basin Montane Riparian & Swamp Forest

Learn more about Aspen and Mixed Conifer Ecological System in the Montana Field Guide[5].

There are likely additional Quaking Aspen Ecological Systems in Montana, but they have not been formally named or defined. As explained by retired MTNHP Ecologist, Stephen Cooper (2022), there are particular areas in Montana, such as east of the Rocky Mountain Front, where Quaking Aspen trees are almost always found on eolian soils (of varying depth); these soils were deposited post-Pleistocene from materials swept from denuded surfaces that were exposed when glaciers receded. Therefore, ecologists have speculated that at least some clones have been in existence for thousands of years. Eolian soils are predominantly loams and highly productive, both for trees and undergrowth. The amount of litter produced, especially on moist sites, can be quite abundant, forming a thick organic layer. Native conifers have difficulty establishing in this deep layer of plant litter. Along the Rocky Mountain Front, many aspen stands, especially on the Blackfeet Indian Reservation show little to no conifer incursion and thus should be considered fire-independent (Shinneman et al. 2013). In these stands, Quaking Aspen sprouts have no problem penetrating through the litter/duff layer.

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[5] Montana Ecological Systems Field Guide: https://fieldguide.mt.gov/displayES_Detail.aspx?ES=4302

RATIONALE FOR PLANT COMMUNITY OF GREATEST CONSERVATION NEED

Quaking Aspen communities have great historical and cultural significance. Since European settlement, there have been concerns that Quaking Aspen plant communities are declining in some parts of the United States (Bartos and Campbell 1998; Campbell and Bartos 2001; Bartos 2001; Shepperd et al. 2006; Nevada Today 2021). For many Native American Tribes in Montana, such as with the Blackfeet Nation, Quaking Aspen are culturally important plants. Various land managers in Montana have noticed that Quaking Aspen stands are tending to be dominated by older, decadent and dying stems (Spoelma 2021; Skinner 2022) (Photo 4). A small study of Quaking Aspen plots in northern Idaho and western Montana, found diminishing or retreating stands at 50% (20) of the 40 plots occurring west of the Continental Divide and at 8% (2) of the 36 plots east of the Divide (Steed and Kearns 2010). The main agents that threaten the persistence of Quaking Aspen communities in Montana include excessive ungulate herbivory, advancing plant succession, lack of fire, human alterations on the landscape, and climate change (Rogers et al. 2014). It is for these reasons, coupled with their ecological and cultural importance that Quaking Aspen communities are a Plant Community of Greatest Conservation Need (GCN) in Montana.

Quaking Aspen, Agents, & Landscape Interactions

There is a growing amount of research demonstrating that Quaking Aspen community types differ in their botanical composition and in the dominant ecological processes that allow the type to persist (Rogers et al. 2014; Rogers 2017). As examples, wildfire plays a role in the persistence of some, but not all Quaking Aspen community types; likewise, beavers are engineers in some Quaking Aspen types, but not in others, such as the riparian aspen types (Rogers et al. 2014). The aspen community type is influenced by the resources available in the particular setting, such as type of agent (excessive ungulate herbivory, advancing plant succession, lack of fire, human alterations on the landscape, or climate change), and intensity, frequency,

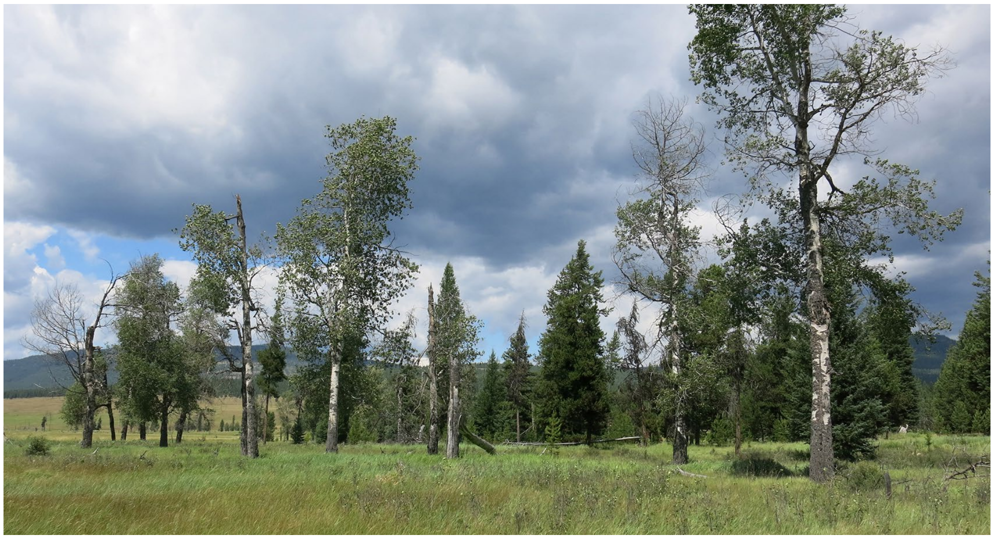
Photo credit Beverly Skinner

Photo 4. A declining Quaking Aspen Community in Montana. Note the age structure which consists of a few larger trees with partially dead canopies and little, if any, regeneration.

duration, and interaction of these agents. The complex ways in which factors interact requires land managers to monitor, communicate, and collaborate on a functional framework to improve the management of these habitats (Campbell and Bartos 2001; Rogers et al. 2014; Rogers 2017). We encourage private landowners and public land managers to consult with the recommended resources listed in Box 1.

Here we explain how five agents - excessive herbivory, advancing succession, wildfire and suppression, human development, and climate change - interact and impact, negatively or positively, the persistence of Quaking Aspen communities in Montana. The mission is to sustain these aspen communities with high plant and animal species diversity that develop in a mosaic pattern influenced by disturbance agents.

1) Excessive Ungulate Herbivory

Once established in an area, the Quaking Aspen community is likely to persist indefinitely unless new shoots, leaves, bark, and buds are consistently over-browsed, excessively shaded, and/or the understory is over-grazed. Both domestic and native animals— such as bison, cattle, sheep, elk, deer, moose, snowshoe hares, cottontails, and beavers— browse on, damage, or remove Quaking Aspen stems (Bork et al. 2013; Runyon et al. 2014) (Photos 5 and 6). Quaking Aspen plant communities that are in proper functioning condition exhibit multiple canopy layers (vertical stratification) made up of young to old trees, regenerating young sprouts, and a diverse plant species understory (Campbell and Bartos 2001). Longevity of the clone is reliant on a continual recruitment of young stems that live to varying

Box 1. Useful Quaking Aspen resources recommended for private landowners and public land managers.

Website

- *Western Aspen Alliance website:* https://western-aspen-alliance.org/index
- Aspen Bibliography – Digital Commons, Utah State University, University Libraries: https://digitalcommons.usu.edu/aspen_bib/

Video

- *Fire in the West – Aspen & Fire, A Burning Issue:* https://www.youtube.com/watch?v=6A3LLWW6evk
  Steve Ambrose, Jessica Brewen, Paul Rogers, Stanley Kitchen, and Wayne Shepperd discuss basic aspen ecology and aspen's unique relationship with fire and climate.

Guidebook & Technical Reports

- *Guide to Quaking Aspen Ecology and Management with emphasis on Bureau of Land Management*
- *Lands in the Western United States*: https://qcnr.usu.edu/western-aspen-alliance/files/aspen-field-guide.pdf
- *Climate Change Vulnerability and Adaptation in the Northern Rockies*: https://www.fs.usda.gov/rm/pubs_series/rmrs/gtr/rmrs_gtr374_1.pdf
- *The Status of Tribes and Climate Change Report*: https://www7.nau.edu/itep/main/docs/publications/ITEP.STACC.Report_2021.pdf
  This report can assist non-tribal land managers in how to work with Tribes on many topics, including Quaking Aspen communities.

Scientific Papers [Available through Aspen Bibliography]

- *A Functional Framework for Improved Management of Western North American Aspen* (*Populus tremuloides* Michx.) - Rogers et al. 2014
- *Tamm Review: Quaking Aspen's Influence on Fire Occurrence, Behavior, and Severity* – Nesbit et al. 2023
- *Fire Regimes of Quaking Aspen in the Mountain West* - Shinneman et al. 2013
- *Aspen Ecosystems: Objectives for Sustaining Biodiversity* - Campbell and Bartos 2001

ages, particularly in stable stands (Rogers 2017). Through herbivory, both domestic and native animals help stimulate Quaking Aspen to regenerate and branch (Rogers and Mittanck 2014). It is when browsing intensity and timing are out of balance with food resources that these clonal communities can be over-used (Rogers 2017). Over-browsing often takes place when livestock are seeking nutrients and forage grasses are becoming dormant and less palatable (Beck and Peek 2005). Over-browsing, rubbing, and trampling can also lead to fungal canker diseases which reduce vigor and increase mortality of aspen stems (Steed and Kearns 2010). Removing an excessive quantity of leaves, buds, and new shoots, and stripping the thin nutritious bark, weakens the community of aspen stems over time. As the trees age and weaken, while new shoots are constantly removed, the clone is eventually no longer able to sustain the underground root mass and ultimately dies. Regulated hunting and wild predators - like bears, wolves, and mountain lions - can help maintain ungulate populations and reduce intensive herbivory (Montana Native Plant Strategy-Quaking Aspen Working Group 2023).

In riparian environments, the interaction of native ungulates and beavers can lead to disastrous impacts on Quaking Aspen communities under specific circumstances. An example occurred in an area north of Yellowstone National Park, in what ecologist Paul Rogers called a "collision of two keystone species". In this area beavers excessively removed trees, and afterwards too many ungulates came in and removed the buds and sprouts of the remaining trees, which resulted in a collapse of the entire Quaking Aspen stand (Runyon et al. 2014; Bennett et al. 2019). In the absence of heavy ungulate browsing, beaver and aspen function in synchrony which usually expands a wetland and diversifies plant and animal communities. Quaking Aspen communities are dynamic systems that naturally change over time; however, excessive browsing by livestock and wildlife should be addressed within the larger landscape if these communities are to persist (Campbell and Bartos 2001; Rogers and Mittanck 2014).

A consequence of livestock grazing practices initiated by European settlement is the introduction of non-native forage grasses

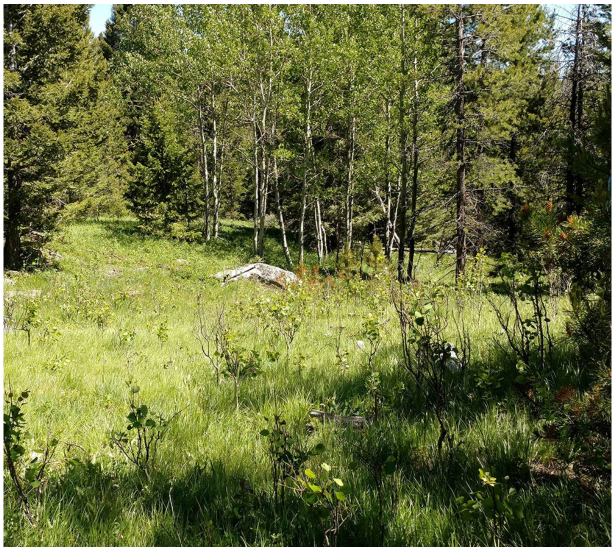

Photo credit Brytten Steed

Photo 5. Heavy ungulate browse caused dieback and stunting of Quaking Aspen sprouts and saplings.

Photo credit Paul C. Rogers

Photo 6. Participants at a 2021 Quaking Aspen workshop discuss excessive browsing and bark scarring from elk. This aspen stand shows scarred and dying stems (center foreground) and little successful regeneration.

(other examples are seeding non-native grasses, modifying hydrology with irrigation diversions, and de-watering areas). Many Quaking Aspen stands have completely converted from an understory composed of native shrubs, forbs, and graminoids to that of introduced forbs and grasses, such as Kentucky Bluegrass (*Poa pratensis*) and Timothy (*Phleum pratense)* (Cooper 2022; Manning 2023). In some cases, these introduced grasses were intentionally established into moist environments (Cooper 2022). The consequence of these introductions is a loss in native plant diversity and the functions that native grasses perform within and around Quaking Aspen communities.

2) *Advancing Succession*

Forests are dynamic places. Disturbance regimes (e.g., wildfire, avalanches, grazing, drought, flooding), ecological plant succession, climate patterns, and other factors change over time and have the potential to alter the structure and species dominance of any forest. Each tree species is designed by nature to grow best within a range of environmental conditions, such as light, soil type, rainfall, humidity, and others. Quaking Aspen stems are generally shade averse, meaning that they grow best in full sun but are often weakened or out-competed when shaded, especially by long-lived, shade-tolerant conifers. As a result, conifers are often perceived as a threat to the persistence of Quaking Aspen in mixed conifer-aspen communities. Yet "conifer encroachment" is simply forest succession in the absence of other naturally occurring disturbances. To avoid placing judgement on the conifers, a more ecologically appropriate term is "advancing succession" (Photo 7). In a study of Quaking Aspen in western Montana and northern Idaho, researchers expect that at least 50% of the mature aspen-plots west of the Continental Divide will succeed to a spruce (*Picea* spp.), true fir (*Abies* spp.), or Douglas-fir (*Pseudotsuga meniziesii*) forest types and possibly to a Western White Pine (*Pinus monticola*) type in northern Idaho (Steed and Kearns 2010).

Quaking Aspen communities can represent seral or stable communities depending on the physical and biological processes and interactions acting upon them (Rogers et al. 2014) (Photo 8). Understanding the community type (or functional type) is essential when considering the need for management action(s) or interventions (see Box 1).

3) *Altered Wildfire Regimes*

Wildfire directly changes natural forest succession processes. In many instances wildfire improves the resiliency of fire-dependent Quaking Aspen communities (Shinneman et al. 2013; Rogers 2017). However, many stable communities within the *Aspen and Forest Woodland* Ecological System may be considered fire-independent (Shinneman et al. 2013). Fire-independent communities continually regenerate based on incremental

Photo credit Brytten Steed

Photo 7. In the absence of disturbance 'advanced succession' of the forest can result in the gradual loss of seral Quaking Aspen communities. Coniferous trees naturally colonize and create shadier conditions that are not conducive to Quaking Aspen growth and reproduction.

overstory die-off, rather than through stand-replacing mechanisms (Rogers et al. 2014). For any Quaking Aspen community, the removal of above ground stems (trees) can stimulate immediate re-sprouting from the long-lived and continually growing underground root crown (Schier and Campbell 1978). Fire rejuvenates the community by opening the stand and removing competing vegetation, such as conifers (Photo 8). In fire-dependent aspen communities (those requiring fire to persist long-term), suppression of wildfires (especially where herbivory impacts are low), may be causing their decline (Bartos and Campbell 1988). In 2001, wildfires burned large areas of forest in the Bitterroot Mountains of Montana, where Quaking Aspen was previously documented. The amount of aspen that came back by suckering was significant and there is no doubt that the fires regenerated these communities (Spoelma 2021).

Large acreages of regenerating aspen post-fire can help disperse native ungulate use (Korb 2005). If large areas of quaking aspen are burned, post-fire browsing by ungulates can be dispersed across many clones, allowing regenerating stems to outgrow the browse pressure. However, if browsing is intense then excessive herbivory can threaten the persistence of those particular clones.

Photo credit Dee Blank

Photo 8. Seral Quaking Aspen communities. In the absence of periodic fires, natural succession by shade-tolerant conifers can out-compete Quaking Aspen trees.

4) *Development*

Quaking Aspen communities are aesthetically pleasing, providing vibrant colors of green that change to gold as summer turns into autumn. Foliage contrasted with the white and grey speckled bark captures the eye of many photographers and artists in all seasons (Manning 2023). Whether in the viewshed or on one's land, Quaking Aspen trees and communities usually improve property values, and therefore, translate into monetary value (Rogers 2017). Thus, Quaking Aspen communities are sought out for development, such as for house sites, ski resorts, mountain bike trails, off-road vehicle recreational areas, and campgrounds. Without proper planning and management, development activities can cause soil compaction, damage to tree boles and roots, excessive tree removal, and localized air pollution, all of which negatively impact these communities (Rogers 2017). On the other hand, mature Quaking Aspen trees can be hazardous for people because they are naturally susceptible to insect and disease agents that can create rot and instability, resulting in blowdown and stem breakage. Where people recreate and live in aspen communities, it is in our best interest to conduct land management planning in ways that will promote ecological functions and will prevent or reduce deleterious impacts to people and aspen trees.

5) *Climate Change*

Long-term shifts in warming and drying weather patterns define climate change (United Nations

2023[6]). These shifts can be driven singularly or in combination with natural phenomena and human activities (United Nations 2023). The consequences of a changing climate relative to Montana include intense droughts, water scarcity, severe fires, rising sea levels, flooding, catastrophic storms, and declining biodiversity (United Nations 2023). Researchers at the University of Nevada used the U.S. Forest Service's Forest Inventory Analysis (FIA) database to assess the status of Quaking Aspen relative to climate (Refsland and Cushman 2021). The research concluded that increased aspen mortality and reduced growth rates were expected in areas projected to have hotter, drier conditions in the future. Researchers at the Rocky Mountain Research Station in Idaho developed a bioclimate model to define aspen's climate profile in the western US (Rehfeldt et al. 2009); the study provided compelling evidence that aspen's current climate profile will likely shrink by 10-40% by 2030 (Rehfeldt et al. 2009). Further, moisture stressors may be what will limit aspen's distribution at the fringe of dry environments (Rehfeldt et al. 2009). Others have concluded the opposite, where aspen may expand because of increased disturbances and new seeding opportunities (Yang et al. 2015; Kreider et al. 2021). In any case Quaking Aspen may be the prime indicator species to use for tracking impacts of a changing climate on forest growth and productivity (Rehfeldt et al. 2009).

How climate change plays out for both the distribution and persistence of Quaking Aspen communities in Montana is unknown, but it will likely vary from location to location within our state. Ultimately, the interactions of shifting weather patterns, increased herbivory, increased levels of insect defoliation and pathogens, wildfire, advanced succession, human development, and management actions drive the direction for Quaking Aspen communities in any location. Additionally, we are beginning to learn more about aspen seedling establishment (i.e., new clones or genotypes). Practices that consider post-disturbance seeding opportunities, methods for identifying true seedlings and their interaction with silviculture, browse management, and climate changes - that both inhibit and promote species migration - will certainly define the future of effective aspen stewardship (Long and Mock 2012; Kreider et al. 2021). Uncertainty has led a network of land managers, ecologists, and foresters in Montana to list climate change as a threat to Quaking Aspen; yet these rising concerns might also create opportunities. A partnership of national forests and national parks in the Northern Rocky Mountains working on climate change issues recently published a technical report titled Climate Change Vulnerability and Adaptation in the Northern Rockies (Halofsky 2018) (Box 1). The partnership conducted a climate change vulnerability assessment and developed solutions intended to minimize negative effects of climate change on forest vegetation and six other natural and cultural resources. The report included an assessment of Quaking Aspen communities. The report demonstrates what has been concluded in this profile, that the response of Quaking Aspen Communities to climate change will depend upon the community type and the more local interactions among agents and factors.

Tribal communities are also developing approaches for addressing climate change, in addition to managing and caring for Quaking Aspen communities. A useful and recommended reference to help all people work in concert with Tribes is The Status of Tribes and Climate Change Report (STACC Working Group 2021) (Box 1).

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[6] United Nations. 2023. What is Climate Change? https://www.un.org/en/climatechange/what-is-climate-change [5 April 2023]

CONSERVATION GOALS & OBJECTIVES

STRATEGIC GOAL: To sustain Quaking Aspen communities with high plant and animal diversity which develops in a mosaic pattern from (emulating) natural ecological processes.

To effectively conserve Quaking Aspen Communities of GCN requires a fusion of approaches involving academic researchers, land managers (biologists, botanists, etc.), landowners, and educators, and possibly economic and political elements to ensure their long-term persistence in Montana. Here in the conservation profile for Quaking Aspen communities in Montana, we present goals and suggest voluntary conservation objectives from four areas that are pillars of plant conservation:

- Information Needs [Inventory, Monitoring, Research]
- Protection and Restoration
- Outreach and Education
- Policy and Regulation

The conservation objectives were developed by a Quaking Aspen Working Group that met and interacted in 2023 and 2024, and are based on published research, monitoring, professional expertise, and field observations. In addition, conservation objectives or actions from other strategies were reviewed and cross-walked with this *Strategy*[7] to relay the idea that tactics can promote collaboration. The Quaking Aspen Working Group that wrote this profile consisted of biologists, ecologists, botanists, and researchers working for or retired from federal and state land management agencies, non-governmental organizations, a Tribal nation, and a university (see Table 1 on page *iii* of the *Strategy*).

The conservation objectives aim to create a voluntary strategic approach that emphasizes statewide coordination and management that emulates natural processes in order to sustain Montana's Quaking Aspen community types. Included in this approach are efforts to boost public education, protect, restore, encourage people to incorporate Native Americans and their botanical knowledge, and to collaborate on policies that can work across jurisdictions. Working within and across jurisdictional boundaries, these voluntary conservation objectives are intended to empower urban and wildland land managers, landowners, non-governmental organization leaders, and individuals who want to contribute to or collaborate on processes that help to sustain Quaking Aspen communities across the Montana landscape.

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[7] Montana Forest Action Plan (Montana Forest Action Advisory Council 2020): https://dnrc.mt.gov/_docs/forestry/Montana_Forest_Action_Plan_12.22.2020.pdf
Montana State Wildlife Action Plan (MFWP 2015): https://fwp.mt.gov/binaries/content/assets/fwp/gisresources/docs/swap/70169.pdf

Information Needs [Inventory, Monitoring, Research]

Conservation Goal

Improve scientific and cultural understandings of the Quaking Aspen community types in Montana and the ecological processes that sustain them through statewide coordination, inventory, monitoring, and research.

Overall Conservation Objectives for Information Needs

1) Establish the Quaking Aspen Working Group in Montana. A statewide working group of professionals who engage on issues related to Quaking Aspen could address, evaluate, and/or provide resources and guidance relative to aspen community information, ecology, research needs and priorities, management, and other topics.
   a. The formation of a Quaking Aspen Working Group could include, but is not limited to:
      - Private industry, such as nurseries, consultants, private foresters, and Montana Nursery and Landscape Association.
      - Federal land managers, such as BIA, BLM, NPS, and USFS[8].
      - State land managers, such as MTFWP, MTDEQ, and MTDNRC[8].
      - Tribal Nations, e.g., Tribal colleges, Elders, traditionalists, ethnobotanists, plant gatherers, biologists, cultural directors, and administrators
      - Non-governmental conservation organizations.
      - Academic researchers, such as those who study restoration, remediation, fire ecology, botany, entomology, forest pathogens, and others.
      - Members of the former aspen working group.

   b. Recommended statewide topics for a Quaking Aspen Working Group to address include, but are not limited to:
      - Conduct a thorough review of protocols used to identify, map, quantify conditions, and classify Quaking Aspen stands or communities. A review and list of recommendations would help inform and standardize methods across management jurisdictions within Montana.
      - Identify, define, and map the different community or functional types of Quaking Aspen in Montana.
      - Define the types of inventory methods and monitoring protocols to achieve various management objectives (e.g., Rogers 2017).
      - Explore the use of remote sensing technology to identify aspen stands and communities.

2) Collaborate or consult with the Western Aspen Alliance[9] to develop best practices for retaining or managing Quaking Aspen communities in Montana. The Western Aspen Alliance provides a network of practitioners (with technical expertise on research, management practices, and policy) and serves as a hub for sharing and reporting information on Quaking Aspen.

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[8] Refer to the "Acronyms and Abbreviations" section at the end of the Strategy.

[9] Western Aspen Alliance: https://western-aspen-alliance.org/index

Information Needs [Inventory, Monitoring, Research]

3) Improve information sharing to agency leads and GIS managers from MTNHP by providing Feature Services as a means to provide Quaking Aspen Community and species observation data.

Conservation Objectives for Inventory and Monitoring

1) Share field-based Quaking Aspen presence/absence observations and mapping with the MTNHP through data exchanges, data collection forms or apps, and/or Global Positioning System (GPS) data and shapefiles, along with photographs. The MTNHP is a statewide database that houses native and exotic field-based plant observation data that is used to create distribution maps and suitable habitat models, conduct status assessments, and fulfil requests for information for the purposes of stewardship.

2) Improve the inventory of Quaking Aspen trees and communities across Montana, including small aspen stands, mixed aspen-conifer stands, and wildland-urban interfaces. Recommended opportunities for improvement include, but are not limited to:

   a. Continue existing Quaking aspen inventory work conducted by federal and state land management agencies, non-governmental organizations, academia, and others.
   b. Conduct surveys in places where data is old or lacking. Current data and mapping is needed to improve project planning and distributional maps (historical and present), status assessments (including tracking trends), suitable habitat models, and other stewardship activities.
   c. At their discretion, collaborate with Tribal Nations in Montana to assist, as needed, in their efforts to obtain resources and collect information on Quaking Aspen communities.
   d. Expand Quaking Aspen canopy assessments across all land management jurisdictions, including municipalities. This includes compiling data from wildland-urban interface, urban, and wildland databases, looking at mapped stands, and tracking changes over time (monitoring) to improve collaboration and information sharing.
   e. Assist community leaders, fire officials, and land management agencies by identifying and mapping existing aspen communities in the wildland-urban interface because they can enhance the "defensible space" around infrastructure. Properly functioning Quaking Aspen communities have the ability to mitigate fire severity and behavior because of their ability to sequester and hold moisture (Nesbit et al. 2023).

3) Identify declining or stagnant aspen communities in the wildland-urban interface as potential treatment areas. Identifying and prioritizing potential treatment areas would aid land managers to determine prescriptions, direct resources, or improve conditions, especially in areas that have a higher risk for wildfire events.

4) Where adjustments in livestock management techniques are made, set-up monitoring to document changes in aspen regeneration, and adjust monitoring plan or permits as appropriate. Consider sharing monitoring results by writing and disseminating reports and giving presentations.

Information Needs [Inventory, Monitoring, Research]

5) Where prescribed or natural fire occurs, consider monitoring ungulate populations, browsing levels, and movement patterns.

Conservation Objectives for Research

1) Determine how long Quaking Aspen root crowns can persist at different locations and under varying disturbance intensities in Montana. In 2000, wildfires burned portions of the Bitterroot Mountains. In 2001, participants from the former Quaking Aspen Working Group surveyed and found notable robust growth by aspen that appeared to be more than a seedling event (Manning 2023; Spoelma 2021). Data collected from these site visits could serve as a starting place for additional research.
2) Develop experimental fencing designs aimed at protecting aspen against excessive herbivory (VerCauteren et al. 2007; Kota and Bartos 2010). Currently, there is a lack of best management practices.
    a. Test fence designs at many sites that differ in slope, vegetative characteristics, and other factors. Collect data that evaluates the response of aspen growth and regeneration relative to these fencing designs. Share findings through internal or published reports.
    b. Through research or monitoring determine how long fences need to remain and what benchmarks may be used to decide when fence removal is appropriate.
3) Determine historic fire intervals for Quaking Aspen communities in specified regions of Montana. This determination may be aided by short-term (fire records), medium-term (tree rings), and long-term (ancient pollens and charcoals).
4) Develop long-term research projects that study the effects of climate change on Quaking Aspen communities, including the associated vegetation, mycorrhizal fungi, insects, and disease agents, browsing pressure, water retention, and others.

Protection and Restoration

Conservation Goal

Retain, restore, and/or protect Quaking Aspen communities in Montana through collaboration that furthers the understanding of complex interactions, strives to emulate natural ecological processes, and allow for dynamic processes to evolve in order to sustain systems.

Conservation Objectives for Wildland Forests and Grasslands

1) Support using state and federal financial resources on non-timber tree species to promote regeneration and function of Quaking Aspen communities in locations where site-specific threats appear manageable.
    a. Management interventions will depend on the specific aspen functional type, location, and realistic management objectives. Interventions could include:

- Knocking down, topping, and/or cutting trees to release the clone's apical dominance (hormonal) response
- Type of fire regime (managed wildfire, high severity prescribed fire, or other)
- Forest treatments (removing conifers)
- Altering hydrology (includes beaver management)
- Managing livestock and/or native ungulate populations to achieve the desired restoration outcome. Address both population size and movement patterns of ungulates.
- Cultural practices in accordance to the Tribe (Cultural Burning)

b. Consider using multiple management interventions that are compatible. Manage to restore natural ecological processes to further the persistence of Quaking Aspen communities. Pair management with monitoring and mitigating stressors. Example: Wildfire may establish new aspen stands, but if ungulate herbivory is too intense, regeneration may fail.

c. Manage to address the functional role of different aspen ecological types and fire regimes at stand- and landscape-scales in order to increase restoration success.

d. Where the Quaking Aspen root crown is heavily shaded, consider treatments that allow light to penetrate and soils to warm to help stimulate aspen growth (Spoelma 2021).

e. Aim to retain or restore many locations of Quaking Aspen communities spread across the appropriate landscape, in order to facilitate proper ecological processes and retain or improve the diversity of animal and plant species. Quaking Aspen communities are hotspots for biodiversity, which is best served by having many rather than few occurrences across the landscape.

f. Consult the newer literature on Quaking Aspen ecology, management, and functional types (see Box 1).

2) Encourage prescribed fire and wildland fire where appropriate to encourage landscape diversity with Quaking Aspen as a dynamic component.

3) For the appropriate type of aspen community, use compatible treatments of livestock grazing management with either fire regime (managed wildfire, high severity prescribed fire) or forest treatments (conifer removal) to achieve the desired restoration.

4) Within areas undergoing Quaking Aspen restoration or where excessive use by livestock or native ungulates is occurring, consider protecting aspen trees or communities as necessary to allow for successful Quaking Aspen regeneration. Recommended tactics include, but are not limited to:

a. Install temporary or permanent fencing to protect trees, reduce herbivory or trampling, or lessen soil compaction.

b. Construct 'natural' barriers, such as 'tree fences' (Photo 9).

c. Increase or adjust hunting licenses (e.g., cow tags)

d. Adjust language in the livestock grazing permit.

   e. Reduce the number of livestock that use the area.
   f. Change the season that livestock use the area.
   g. Change the duration of time that livestock use the area.
   h. Protect plantings or natural areas of regenerating Quaking Aspen saplings until they become taller than browse height.
6) Conserve Quaking Aspen communities across the state to assist in the conservation for Animals of GCN as stated in the Montana's State Wildlife Action Plan for Deciduous Dominated Forest and Woodland (MFWP 2015)[10].
7) Conserve Quaking Aspen communities across the state to assist in the conservation for Vascular Plant Species of GCN (Section 4) and other native plant, fungal, and animal species that are part of the community.

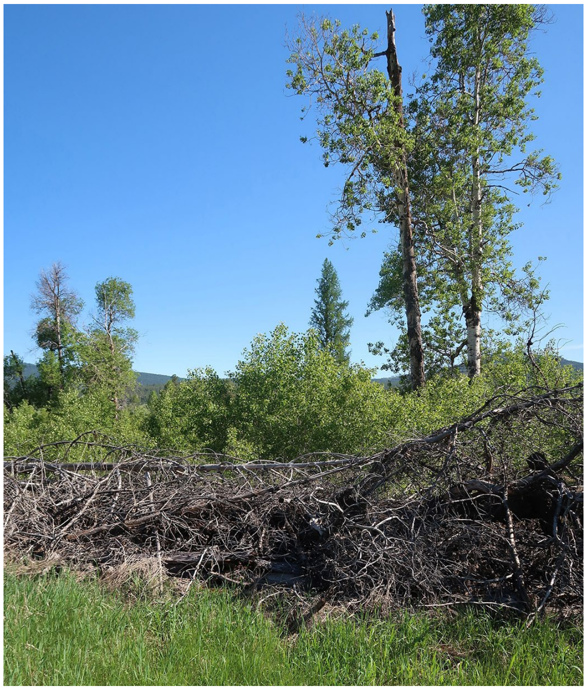
Photo credit Beverly Skinner, USFWS

Photo 9. A constructed 'tree fence' creates a 'natural' barrier to deter over-use by elk and livestock. Growing behind are numerous aspen saplings and decadent mature trees.

Conservation Objectives for Urban and Community Forests

1) Plant Quaking Aspen trees in places that have sufficient horizontal and vertical space for the natural growth of the root crown, such as in semi-wildland areas (Kirby 2021). If not planted where there is sufficient space, Quaking Aspen stems will weaken and the clone may perish along with other plant and animal species in its community. Natural Quaking Aspen communities within developed areas may act as a fire deterrent or buffer because they represent moister places and may calm high-intensity flames in the summer period (Nesbit et al. 2023).
2) Discourage the planting of Quaking Aspen trees into boulevard and urban residential spaces or as isolated plantings (Kirby 2021).
   a. These urban settings do not allow for enough horizontal or vertical space for growth and can result in a failed planting and create unnecessary costs to remove or replace.
   b. Lawn mowers, yard tools, and urban wildlife can scar or wound aspens, predisposing them to certain insects, fungi, or pathogens that could directly or indirectly cause dieback, damage stems, or kill the entire clone. Stems or roots that are damaged or dead can become hazardous trees in urban places.
   c. The natural response to damage is for aspen to sprout or sucker. When suckers are mowed, they can become sharp and hazardous to landowners.

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[10] Montana's State Wildlife Action Plan (2015), pp. 20 and 46 https://fwp.mt.gov/binaries/content/assets/fwp/gisresources/docs/swap/70169.pdf

Protection and Restoration

3) Consult with local MTDNRC offices to ensure that aspen trees are obtained or grown from local, native sources to avoid possible introductions of non-native insects and diseases and to retain the genetic diversity of native plants.

4) Inspect and monitor trees bought from nurseries to detect non-native species, and if found work with the nursery and county extension services on how to eradicate them. For example, Oystershell Scale (*Lepidosaphes ulmi*), an invasive sapsucking insect, was introduced through nursery stock and has been expanding its range and contributing to Quaking Aspen mortality in Arizona and other places (Grady et al. 2022).

5) Support Quaking Aspen management where present in urban and community forest as outlined by the Montana Forest Action Plan (2020)[11] as follows: *Support land management agencies, universities, and other relevant partners in efforts to engage Montanans on the benefits of urban and community forests and the need to maintain and manage urban trees.*

6) Support the sale of native Quaking Aspen for planting where appropriate into the urban-wildland interface as outlined by the Montana Forest Action Plan (2020)[12]: *Encourage nurseries to supply diverse tree species as recommended by the Montana Urban and Community Forestry Association, especially for commercial planting.*

7) Support Quaking Aspen management where present in urban and community forest as outlined by the Montana Forest Action Plan (2020)[13]: *Raise awareness with local government officials about the need for funding to maintain trees after planting in order to provide benefits into the future.*

Outreach and Education

Conservation Goal

Improve educational efforts and outreach between and within land management agencies, Tribal Nations, citizens, and decision-makers about Quaking Aspen ecology, importance to biodiversity, and tactics to sustain their communities in Montana.

Conservation Objectives

1) Educate the public, landowners, land managers, and land-use planners about the "keystone" and water conservation roles that Quaking Aspen communities exhibit. This helps to garner public support and involvement in actions that improve the health and survivorship of these communities. Suggested topics include, but are not limited to:
    a. The dynamic roles, benefits, and interactions that fire ecology, herbivory, and plant succession have on the ecology, growth, and persistence of Quaking Aspen communities.
    b. The different types of Quaking Aspen communities and functional groups.

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[11] Montana Forest Action Plan (2020), p. 70, Goal #1, Bullet 2
[12] Montana Forest Action Plan (2020), p. 70, Goal #1, Bullet 3
[13] Montana Forest Action Plan (2020), p. 70, Goal #1, Bullet 8

Outreach and Education

c. The dynamics between domestic and native ungulates, herbivory, and Quaking Aspen ecology, growth, and persistence.

d. What it means for Quaking Aspen to be called a keystone species. Educate on the values that Quaking Aspen communities provide to all-beings, society, and culture. For example, nurturing species diversity, retaining soil moisture, filtering pollution, and connection with people of all races.

e. Factors that can influence their viability. For example, topics on climate change, excessive herbivory, low-impact recreational opportunities, and fire ecology.

f. Quaking Aspen health and condition and signs or symptoms of damage. Address insect and fungal species pathogens, diseases, life history, environmental threats, and ecological processes.

f. Develop educational materials geared to private landowners about management tactics that enhance and protect Quaking Aspen communities on private land, and the biodiversity benefits they provide.

2) Identify and collaborate with agencies, businesses, and other entities who develop brochures and informational pamphlets for landowners. Ensure that complete, accurate information on Quaking Aspen is relayed appropriately in publications. Topics related to Quaking Aspen trees or communities may include, but are not limited to:

- Wildland Urban Interface planning
- Firewise landscaping
- Selecting tree species for landscaping or for landowners
- Tree planting guidelines for landowner
- Homeowner guides

3) Disseminate developed informational materials to private landowners through regional and local government offices, such as at:

- NRCS service centers
- USFS regional, forests, and districts
- MT/Dakotas BLM state and field offices
- County Extension Services
- Utility companies
- Nurseries
- Landscape businesses and consultants

4) Revise the Quaking Aspen profile on the Montana Field Guide to current MTNHP standards to update and expand known information on life history, ecology, wildlife-plant interactions, identification, biological characteristics, economics, management, threats, taxonomy, and other interesting facts; create links to the Strategy and other online information; and improve readability.

5) Extend invitations to members of Tribal Nations in Montana to engage in conversations, listen to their knowledge, and hear their concerns and needs regarding Quaking Aspen communities.

Outreach and Education

6) Acknowledge Quaking Aspen as a cultural resource in Montana and consult the appropriate approvals from Tribal leaders or Tribal Liaisons in respectful ways of how to incorporate traditional or indigenous uses and management of Quaking Aspen, including the action to not convey.

7) Support educational efforts for Quaking Aspen in urban and community forests as outlined by the Montana Forest Action Plan (2020)[14] as follows: *Actively promote stewardship of and education on the services and value of urban and community forests in an effort to increase urban tree canopy cover.*

Policy and Regulation

Conservation Goal

Facilitate statewide conservation of Quaking Aspen communities through collaboration and the use of existing policies and regulations between and within state and federal land management agencies, Tribal nations, other landowners, decision-makers.

Conservation Objectives

1) Support Quaking Aspen management in wildland forests as outlined by the Montana Forest Action Plan (2020)[15]: *Invest in expanding agency capacity to implement a variety of treatment types, including mechanical treatment and prescribed fire, to increase the pace and scale of restoration treatments in Priority Areas for Focused Attention.*

2) Support Quaking Aspen management in wildland forests as outlined by the Montana Forest Action Plan (2020)[16]: *Work collaboratively with all forest owners, land managers, and communities to implement management activities that maximize ecosystem service benefits.*

3) For affected BLM field offices, prioritize and complete actions to meet goals and objectives for Quaking Aspen management that are included in existing BLM Resource Management Plans.

4) For affected BLM field offices, incorporate Quaking Aspen management strategies into new Resource Management Plans and plan revisions, and potentially identify Quaking Aspen as a priority species for proactive management.

5) Support management activities to increase the aspen component within lodgepole pine and other vegetation types on about 67,000 acres in compliance with the 2009 Beaverhead-Deerlodge Forest Revised Forest Plan (USDA FS 2009). On the Beaverhead-Deerlodge National Forest, Quaking Aspen occupies less than 20% of its estimated historical range (USDA FS 2009).

6) Contact local federal, state, county, and city agencies and inquire on the best ways to provide comments on proposed projects and planning efforts that could impact or promote Quaking Aspen communities or the ecological processes that sustain them.

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[14] Montana Forest Action Plan (2020), p. 71, Goal #2, Bullet 6
[15] Montana Forest Action Plan (2020), p. 37, Goal #1, Bullet 2
[16] Montana Forest Action Plan (2020), p. 37, Goal #1, Bullet 5

REFERENCES

Alexander, M.; R. Lanoville. 2004. The International Crown Fire Modelling Experiment fuel treatment trials [abstract]. Page 222 in R. Engstrom, K. Galley, and W. de Groot (eds.). Proceedings of the 22nd Tall Timbers Fire Ecology Conference: Fire in Temperate, Boreal, and Montane Ecosystems. Tall Timbers Research Station, Tallahassee, FL. https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=1581273048712feecb3ab97000bc71ed00bf5c6d

American Society of Landscape Architects (ASLA). 2023. Improving Water Efficiency: Residential Bioswales and Bioretention Ponds. Washington, D.C. https://www.asla.org/bioswales.aspx [5 April]

Bartos, D. 2001. Landscape dynamics of aspen and conifer forests. *In*: Sheppard, W., D. Binkley, D. Bartos, T. Stohlgren, and L. Eskew (Comps.). Sustaining aspen in western landscapes: Symposium proceedings; 13-15 June 2000; Grand Junction, CO. USDA Forest Service Proceedings RMRS-P-18, 460p. Rocky Mountain Research Station, Fort Collins, CO: 5–14.

Bartos, D.; R. Campbell. 1998. Decline of Quaking Aspen in the Interior West – Examples from Utah. Rangelands. 20: 17–24.

Beck, J.; J. Peek. 2005. Diet composition, forage selection, and potential forage competition among elk, deer, and livestock on aspen-sagebrush summer range. Rangeland Ecology and Management. 58: 135-147.

Bennett, S.; N. Bouwes; P. Rogers. 2019. Beaver and aspen: Synergy among keystone species. Western Aspen Alliance. Logan, UT: Utah State University. 2 p. https://western-aspen-alliance.org/files/briefs/WAA_Brief6_Beaver_final_.pdf

Bork, E.; C. Carlyle; J. Cahill [et al.]. 2013. Disentangling herbivore impacts on *Populus tremuloides*: A comparison of native ungulates and cattle in Canada's Aspen Parkland. Oecologia. 173: 895-904.

Burns, R.; B. Honkala (Technical coordinators). 1990. Silvics of North America: Vol. 2, Hardwoods. Agricultural Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC. 877 p.

Campbell, R.; D. Bartos. 2001. Aspen ecosystems: objectives for sustaining biodiversity. In: Sheppard, W; Binkley, D.; Bartos, D.; Stohlgren, T.; and Eskew, L. (eds.) RMRS-P-18. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 299–307. https://www.fs.usda.gov/rm/pubs/rmrs_p018/rmrs_p018_299_310.pdf [2 April]

Chang M. 2006. Forest hydrology: an introduction to water and forests. Boca Raton (FL): CRC Press, p 373.

Cooper, S. 2022. Personal communication. Retired ecologist, Montana Natural Heritage Program, Helena, MT [16 May 2022].

Cripps, C. 2003. Native mycorrhizal fungi with aspen on smelter-impacted sites in the Northern Rocky Mountains: Occurrence and potential use in reclamation. American Society of Mining and Reclamation. https://plantsciences.montana.edu/facultyorstaff/faculty/cripps/0193-Cripps.pdf [5 April]

DeByle, N.; R. Winokur (eds.). 1985. Aspen: Ecology and management in the western United States. Gen. Tech. Rep. RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 283 p.

Earnst, S.; D. Dobkin; J. Ballard. 2012. Changes in avian and plant communities of aspen woodlands over 12 years after livestock removal in the northwestern Great Basin. Conservation Biology 26: pp. 862-872.

Ekenwalder, J. 2010. Populus. In: Flora of North America (FNA) Editorial Committee, eds. 1993+. Flora of North America North of Mexico. 25+ vols. New York and Oxford. Vol. 3, pp. 356-357.

Fechner, G; J. Barrows. 1976. Aspen stands as wildfire fuel breaks. Eisenhower Consortium Bulletin 4. June. Colorado State University, Fort Collins, CO. https://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=6024&context=aspen_bib

Gifford, G.; W. Humphries; R. Jaynes. 1984. A preliminary quantification of the impacts of aspen to conifer succession on water yield. II. Modeling results. Water Resources Bulletin 20: pp.181-186.

Grady, A.; C. Crouch, N. Wilhelmi, R. Hofstetter, K. Waring. 2022. Oystershell Scale: An Invasive Threat to Aspen Conservation. May. Western Aspen Alliance Brief Number 8., Utah State University, Ogden, UT.

Halofsky, J.; D. Peterson; S. Dante-Wood [et al.] (eds.). 2018. Climate change vulnerability and adaptation in the Northern Rocky Mountains. Part 1. Gen. Tech. Rep. RMRSGTR-374. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 273 p. https://www.fs.usda.gov/rm/pubs_series/rmrs/gtr/rmrs_gtr374_1.pdf

Harniss, R.; K. Harper. 1982. Tree dynamics in seral and stable aspen stands of central Utah. RP-INT-297. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, UT. 7 p.

Hiemstra C.; G. Liston; W. Reiners. 2006. Observing, modelling, and validating snow redistribution by wind in a Wyoming upper treeline landscape. Ecol Model 197(1–2):35–51.

Jones, J.; N. Debyle. 1985. Fire. P. 77–81 in Aspen: *Ecology and management in the western United States*, DeByle, N., and R. Winokur (eds.). USDA For. Serv., Gen. Tech. Rep. RM-GTR-119, Fort Collins, CO.

Kirby, J. 2021. An interview with Jamie Kirby and Amy Gannon. September 20th. Jamie Kirby (Urban Forester) and Amy Gannon (Forest Entomologist), Department of Natural Resources and Conservation, Missoula, Montana. Interviewed by Andrea Pipp, Botanist, Montana Natural Heritage Program, Helena, MT.

Korb, N. 2005. Historical fire regimes and structures of Douglas-fir forests in the Centennial Valley of southwest Montana. Thesis. Colorado State University, Fort Collins, CO.

Kota, A.; D. Bartos. 2010. Evaluation of techniques to protect aspen suckers from ungulate browsing in the Black Hills. Western Journal of Applied Forestry. 25: 161-168.

Kreider, M.; L. Yocom. 2021. Aspen seedling establishment, survival, and growth following a high-severity wildfire. Forest Ecology and Management. 493: 119248.

Kuhn, T.; H. Safford; B. Jones; K. Tate. 2011. Aspen (Populus tremuloides) stands and their cotnribution to plant diversity in a semiarid coniferous landscape. Plant Ecol. 212: 1451-1463.

Lesica, P.; M. Lavin; P. Stickney. 2022. Manual of Montana Vascular Plants, Second Edition. Fort Worth, TX: BRIT Press. viii + 779 p.

LaMalfa, E.; R. Ryel [Ryle sic]. 2008. Differential snowpack accumulation and water dynamics in aspen and conifer communities: Implications for water yield and ecosystem function. Ecosystems 11(4): 569-581.

Long, J.; K. Mock. 2012. Changing perspectives on regeneration ecology and genetic diversity in western quaking aspen: Implications for silviculture. Canadian Journal of Forest Research. 42: 2011-2021.

Manning, M. 2023. Personal Communications. Regional Ecologist, U.S. Forest Service, Region 1, Missoula, Montana [April-May].

Montana Fish, Wildlife & Parks [MFWP]. 2015. Montana's State Wildlife Action Plan. Helena, MT. 441 p.

Montana Forest Action Advisory Council. 2020. Montana Forest Action Plan. December. Convened by the Montana Department of Natural Resources and Conservation, Helena, MT. https://dnrc.mt.gov/Forestry/Forest-Management/montana-forest-action-plan

Montana Native Plant Conservation Strategy - Quaking Aspen Working Group. 2023. Meetings, document review, and electronic mail correspondences. April to May 2023 and February to March 2024. Available from Andrea Pipp, Montana Natural Heritage Program, Helena, MT.

Montana Natural Heritage Program [MTNHP]. 2023a. Observation data on Populus tremuloides in the botany database. MTNHP, Helena, MT. [May 2023].

Montana Natural Heritage Program [MTNHP]. 2023b. *Populus tremuloides* profile. In: Montana Field Guide. https://fieldguide.mt.gov/speciesDetail.aspx?elcode=PDSAL010B0 [2 March 2023].

Montana Natural Heritage Program [MTNHP]. 2023b. Ecological Systems. In: Montana Field Guide. https://fieldguide.mt.gov/default.aspx [April 2023].

Mueggler, W. 1988. Aspen community types of the Intermountain Region. General Technical Report INT-250. U.S Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, UT. 135 p

Nesbit, K.; L. Yocom; A. Trudgeon [et al.]. 2023. Tamm review: Quaking Aspen's influence on fire occurrence, behavior, and severity. Forest Ecology and Management. 531: 120752.

NevadaToday. 2021. Continent-wide Decline of Aspen Driven by Climate Change. November 1st. Obtained on April 5th at https://www.unr.edu/nevada-today/news/2021/aspen-tree-decline

Pipp, A. 2023. Personal Communication. Landscaping Committee Lead, St. Paul's United Methodist Church, Helena, MT. [2002-2007]

Rehfeldt, G.; D. Ferguson; N. Crookston. 2009. Aspen, climate, and sudden decline in western USA. Forest Ecology and Management 258:2353-2364.

Refsland, T.; J. Cushman. 2021. Continent-wide synthesis of the long-term population dynamics of quaking aspen in the face of accelerating human impacts. Oecologia. 197: 25-42.

Rogers, P.C. 2017. Guide to Quaking Aspen ecology and management with emphasis on Bureau of Land Management Lands in the Western United States. Logan, UT: Western Aspen Alliance, Wildland Resources Department and Ecology Center, Utah State University. https://western-aspen-alliance.org/files/AspenFieldGuide_050817_final4.pdf [8 March 2023].

Rogers, P.C.; D. Bartos; R. Ryel. 2011. Historical patterns in lichen communities of montane Quaking Aspen forests. In: Daniels, J., ed. Advances in environmental research, Vol. 15. Hauppauge, NY: Nova Science Publishers, Inc.: 33-64.

Rogers, P.C; S. Landhausser; B. Pinno; R. Ryel. 2014. A functional framework for improved management of Western North American aspen (*Populus tremuloides* Michx.). Forest Science. 60(2): 345-359. http://dx.doi.org/10.5849/forsci.12-156 [2 April 2023].

Rogers, P.C; C. Mittanck. 2014. Herbivory strains resilience in drought-prone aspen landscapes of the western United States. Journal of Vegetation Science, 25: 457-469.

Runyon, M.; D. Tyers; B. Sowell; C. Gower. 2014. Aspen restoration using beaver on the northern Yellowstone winter range under reduced ungulate herbivory. Restoration Ecology. 22: 555-561.

Sallabanks, R. [et al.]. 2001. In: Johnson, D.; O'Neil, T. (Managing Directors). Wildlife-habitat relationships in Oregon and Washington. Corvalis, OR: Oregon State University Press. 736 p.

Schier, G.; R. Campbell. 1978. Aspen sucker regeneration following burning and clearcutting on two sites in the Rocky Mountains. Forest Science 24:303-308.

Shepperd W.; P.C. Rogers; D. Burton; D. Bartos. 2006. Ecology, biodiversity, management, and restoration of aspen in the Sierra Nevada. General technical report RMRS-GTR-178, USDA Forest Service, Rocky Mountain Research Station, Fort Collins, SO

Shinneman, D.; W. Baker; P.C. Rogers; D. Kulakowski. 2013. Fire regimes of quaking aspen in the Mountain West. Forest Ecology and Management. 299: 22-34.

Skinner, B. 2021. Interview with Beverly Skinner, Habitat Biolgoist, U.S. Fish and Wildlife Service, Lost Trail National Wildlife Refuge, Marion, MT. Conducted by Andrea Pipp, Botanist, Montana Natural Heritage Program, Helena, MT. [29 September].

Spoelma, T. 2021. Interview with Tim Spoelma. Forester, Department of Natural Resources and Conservation, Missoula, MT. Conducted by Andrea Pipp, Montana Natural Heritage Program, Helena, MT. [25 September].

Status of Tribes and Climate Change Working Group (STACCWG; D. Marks-Marino, editor). 2021. Status of Tribes and Climate Change Report, Institute for Tribal Environmental Professionals, Northern Arizona University, Flagstaff, AZ https://www7.nau.edu/itep/main/docs/publications/ITEP.STACC.Report_2021.pdf

Steed, B.; H. Kearns. 2010. Damage agents and condition of mature aspen stands in Montana and Northern Idaho. Forest Health Production Numbered Report 10-03. U.S. Department of Agriculture, Forest Service, Region 1, Missoula, MT. https://digitalcommons.usu.edu/aspen_bib/7202/ [3 April 2023]

Urban Forestry Outreach and Research Nursery and Lab. 2023. Quaking Aspen – *Populus tremuloides* profile. University of Minnesota, Minnesota. https://www.dnr.state.mn.us/trees/quaking-aspen.html [5 April].

U.S. Department of Agriculture, Forest Service [USDA FS]. 2009. Beaverhead-Deerlodge National Forest Land and Resource Management Plan. U.S. Department of Agriculture, Forest Service, Beaverhead-Deerlodge National Forest, Dillon, MT. 504 p.

U.S. Department of Agriculture, Forest Service [USDA FS]. 2024. How Aspens Grow. US Forest Service, Washington, D.C. https://www.fs.usda.gov/wildflowers/beauty/aspen/grow.shtml [10March 2024]

United States National Vegetation Classification [USNVC]. 2023. National Classification for vegetation in the United States. https://usnvc.org/ [13 March 2023].

Vance, L.; T. Luna; M. Hart. 2017a. Aspen Forest and Woodland Ecological System profile. In: Montana Field Guide. Helena, MT: Montana Natural Heritage Program. https://fieldguide.mt.gov/displayES_Detail.aspx?ES=4104 [2 March 2023].

Vance, L.; T. Luna; M. Hart. 2017b. Aspen and Mixed Conifer Forest Ecological System In: Montana Field Guide. Helena, MT: Montana Natural Heritage Program. https://fieldguide.mt.gov/displayES_Detail.aspx?ES=4302 [2 March 2023].

VerCauteren, K.; N. Seward; M. Lavelle, [et al.]. 2007. A fence design for excluding elk without impeding other wildlife. Rangeland Ecology and Management. 60: 529-532.

Yang, J.; P. Weisberg; D. Shinneman [et al.]. 2015. Fire modulates climate change response of simulated aspen distribution across topoclimatic gradients in a semi-arid montane landscape. Landscape Ecology. 30:1055-1073.

APPENDIX D

Montana’s Herbaria

STATE HERBARIA IN MONTANA

University of Montana Herbarium [MONTU]	
Location	▪ Mailing address: Herbarium, Biological Sciences Division, University of Montana, Missoula. MT 59812 ▪ Physical location: 302/303 Natural Sciences, University of Montana, Missoula ▪ Website: https://hs.umt.edu/herbarium/default.php
Curator/ Collection Manager	Giovanna Bishop. Email: giovanna.bishop@mso.umt.edu
Mission Statement	To continue to assemble and maintain a collection of the flora of the Western Cordillera and Great Plains, including those circumboreal genera with representatives in this region.
Collections	▪ Approximately 135,000 vascular plants. Of these, roughly 79,000 specimens and labels are digitized; and roughly 76,000 specimens are imaged and accessible on the Consortium of Pacific Northwest Herbaria portal at: https://www.pnwherbaria.org/data/search.php ▪ Approximately 3,000 mosses. The Montana specimens are accessible at the Consortium of Bryophyte Herbaria at: https://bryophyteportal.org/portal/ ▪ Approximately 2,000 lichens (which are in need of digitizing) ▪ Approximately 6,200 diatom slides representing the Montana Diatom Collection ▪ Approximately 16,000 specimens from the Missoula Research Center [MRC] herbarium, curated by Dr. Peter Stickney and housed at MONTU, are being digitized and will be accessible at: http://hs.umt.edu/herbarium/default.php ▪ Fungal collections are being re-instated in 2024
Support Group	Friends of the University of Montana Herbarium: https://www.umt.edu/herbarium/friends-of-the-herbarium/friends.php
Strategic Plan	The University of Montana Herbarium 2021 Strategic Planning Document: https://www.umt.edu/herbarium/friends-of-the-herbarium/strategic-plan.php
Services	▪ Open to the public by appointment ▪ Herbarium tours ▪ Assistance with plant identification and querying digital data ▪ Specimen loans and digital data by request

STATE HERBARIA IN MONTANA

Montana State University [MONT]

Location	■ Mailing address: Department of Plant Sciences and Plant Pathology, P.O. Box 173150, Montana State University, Bozeman, MT 59717-3150 ■ Physical location: 408 Lewis Hall, Montana State University, Bozeman ■ Website: https://www.montana.edu/mlavin/herb/index.html
Curator	Dr. Matt Lavin, emeritus. Email: mlavin@montana.edu MONT Email Address: msuherbarium@montana.edu
Mission Statement	To focus on the native and introduced flora of Montana and adjacent regions, particularly rangeland and cropland settings. To assist MSU faculty and staff, federal agency staff, and others in plant identification and research, particularly with agricultural and rangeland research. To contribute to efforts that enhance the connectivity of herbaria in Montana and the Pacific Northwest region.
Collections	■ Approximately 80,000 collections of vascular plants. - 55,000 Montana plant collections have been imaged and accessible on the Consortium of Pacific Northwest Herbaria portal at: https://www.pnwherbaria.org/data/search.php, and GBIF at: https://www.gbif.org/dataset/d7c0e1e4-2e93-4e87-8a85-d88b89a4a782 - Yellowstone National Park wetland plant collection duplicates stored at MONT - Type specimens of 253 holotypes and isotypes, primarily collected by such notable botanists as: J.W. Blankenship, P.A. Rydberg, R.S. Williams, L. Constance, C.L. Hitchcock, F.D. Kelsey, J.F MacBride, M. Mathias, A. Nelson, F.W. Pennel, and R.C. Rollins. ■ Approximately 8,000 lichen collections are available online through the Consortium of Lichen Herbaria portal at: https://lichenportal.org/portal/. and GBIF at: https://www.gbif.org/dataset/ae9c6967-ba93-4be4-9890-4952fe0941e0 ■ Former bryophyte collection is on permanent loan to the University of Wisconsin [WISC]. Available by searching on "MONT" at the Consortium of Bryophyte Herbaria at: https://bryophyteportal.org/portal/
Services	■ Open to the public by appointment for research into the plant diversity of Montana ■ Assistance with plant identification and querying digital data ■ Specimen loans to institutions listed in Index Herbariorum, and digital data by request

STATE HERBARIA IN MONTANA

Montana State University-Billings [MSUB]

Location	Physical and mailing address: Montana State University-Billings Herbarium, Yellowstone Science and Health Building, Room 30, Billings, MT 59101
Curator	Dr. Jason Comer. Email: jason.comer@msubillings.edu
Mission	To classify and catalog global floral diversity, prioritizing the Eastern Montana region. MSUB Herbarium provides and promotes botanical education, research, and outreach.
Vision Statement	To become a center for botanical education and research in Eastern Montana. The MSUB herbarium is in a unique position to act as a crossroads for undergraduate students, professionals, and the local community.
Collections	Approximately 12,000 vascular specimens, emphasizing Eastern Montana and the Beartooth Plateau
Services	▪ Open to the public by appointment ▪ Assists MSUB students, MSU Extension Service agents, and government employees in identifying plant specimens. Provides secondary assistance with plant identification. Please email the MSUB Curator to request a Plant ID Request Form and protocol. Citizens should route their plant specimens to their local country extension office first.

FEDERAL HERBARIA IN MONTANA

Glacier National Park [GLAC]

Location	West Glacier, Montana - Mailing address: Glacier National Park, c/o Museum/Archives, PO Box 128, West Glacier, MT 59936 - Physical address: West Glacier - Website: https://www.nps.gov/glac/learn/historyculture/collections.htm
Curator	Jean Tabbert. Email: jean_tabbert@nps.gov
Mission Statement	To continue to assemble and maintain a collection of the Glacier National Park (GNP) flora.
Collections	- 1,182 specimens of known vascular plants - 858 specimens of known moss and lichen taxa - More than 140 specimens of identified fungi
Support Group	Glacier National Park Conservancy
Strategic Plan	*Glacier National Park 2014 Scope of Collection Statement.* Approved by the GNP superintendent.
Services	- Research-grade access by appointment only; no specimen browsing is allowed - Assistance in plant identification from the park's botany staff (subject to staff availability) - Loans to institutions that meet National Park Service (NPS) museum standards

Yellowstone National Park [YELLO]

Location	- Mailing address: Heidi Anderson, Yellowstone National Park, PO Box 168, Mammoth, WY 82190 - Physical address: Heritage and Resources Center, 20 Old Yellowstone Trail, Gardiner, Montana - Website: https://www.nps.gov/yell/learn/nature/herbarium.htm
Curator/ Collection Manager	Heidi Anderson. Email: Heidi_Anderson@nps.gov
Mission Statement	To continue to assemble and maintain a collection of Yellowstone National Park (YNP) flora.
Collections	- Approximately 13,064 vascular plants - Approximately 5,962 mosses and liverworts - Approximately 1,823 lichens, fungi, and other collections. - Extensive collection of wetland plants, including a nearly complete collection of the native aquatic vascular plants found throughout the western United States. - Extensive collection of mosses for YNP and other areas of the Rocky Mountains.
Services	- Open to the public by appointment - Herbarium tours (by appointment only) that focus on the YNP flora and a summary of the collection - Access to online specimen data is not yet available

FEDERAL HERBARIA IN MONTANA

Beaverhead-Deerlodge NF Herbarium [BDNF]

Location	Beaverhead-Deerlodge National Forest, Dillon, Montana ▪ Mailing address: c/o Jessie Salix, 420 Barrett St., Dillon, MT 59725
Curator/ Collection Manager	Jessie Salix, curator. Email: jessica.salix@usda.gov
Mission Statement	To maintain a collection of the flora that represents the Beaverhead-Deerlodge National Forest and surrounding lands.
Collections	▪ Approximately 1,217 vascular plants ▪ Approximately 170 mosses ▪ Approximately 340 lichens
Services	▪ An agency resource herbarium that is not publicly accessible without prior scheduling with Jessie Salix ▪ Access to online specimen data is not yet available

Bitterroot National Forest Herbarium [BNFH]

Location	▪ Mailing address: c/o Lea Tuttle 1801 North 1st Street Hamilton, MT 59840 ▪ Physical address: Bitterroot National Forest, Hamilton
Curators	▪ Lea Tuttle, curator. Email: lea.tuttle@usda.gov ▪ Laura Johnston, assistant curator. Email: laura.johston@usda.gov
Mission Statement	To maintain a collection of the flora that represents the Bitterroot National Forest (BRF).
Collections	▪ Approximately 1,080 vascular plants ▪ Approximately 53 mosses ▪ Approximately 139 lichens ▪ Approximately 7 liverworts ▪ Three sets of Civilian Conservation Corps (CCC) herbarium plant binders, each with approximately 100 specimens
Services	▪ An agency resource herbarium that is not publicly accessible without prior scheduling with Lea Tuttle ▪ Access to online specimen data is not yet available

PRIVATE HERBARIUM IN MONTANA

Tu-Hi Hong and Pum-Hi Hong Herbarium at Great Falls [GFC]	
Location	University of Providence, Great Falls, Montana ▪ Mailing address: University of Providence, Biology Department, 1301 20th Street South, Great Falls, MT 59405
Curator / Collection Manager	▪ Curated by Dr. Won Shic Hong (deceased) ▪ Maintained by Yoon-Hee Hong. Email: ms.yoonheehong@gmail.com
Collections	▪ Small collection of vascular plants from Montana ▪ Approximately 30,000 liverwort specimens from Korea, Canada, the United States, and other countries. This collection includes specimens representing the Hepaticae (liverworts) found in the state of Montana.
Services	▪ A private herbarium not currently open to the public ▪ Any requests should be directed to Yoon-Hee Hong

Photo Credit: Jane Olson

Photo D-2: At the end of a plant collecting project, a botany crew in Montana poses with plant collecting press, supplies, and a hori-hori tool.

APPENDIX E

Acronyms-Abbreviations, Online Resources, & Glossary

LARGE TYPE
LT --- D-G
LT --- C-D
MANUAL OF MONTANA VASCULAR PLANTS

ACRONYMS AND ABBREVIATONS USED IN THIS STRATEGY

ACEC	Area of Critical Environmental Concern
ACEP	Agricultural Conservation Easement Programs
ALE	Agricultural Land Easements
ASBA	American Society of Botanical Artists
ASLA	American Society of Landscape Architects
BDNF	Beaverhead-Deerlodge National Forest Herbarium
BHDL NF	Beaverhead-Deerlodge National Forest
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BNFH	Bitterroot National Forest Herbarium
BRF	Bitterroot National Forest
CBH	Consortium of Bryophyte Herbaria
CCAA	Candidate Conservation Agreement and Assurances
CCC	Civilian Conservation Corps
CCVI	Climate Change Vulnerability Index
CE	Conservation Easement
CFRTAC	Clark Fork River Technical Assistance Committee
CLH	Consortium of Lichen Herbaria
CNGPH	Consortium of Northern Great Plains Herbaria
CPNWH	Consortium of Pacific Northwest Herbaria
CRP	Conservation Reserve Program
CSKT	Confederated Salish and Kootenai Tribes
CSP	Conservation Stewardship Program
CVA	Centennial Valley Association
ECOS	(USFWS) Environmental Conservation Online Systems
EO	Element Occurrence
EQIP	Environmental Quality Incentive Program
ES	Ecological System
ESA	Endangered Species Act
FOH	Friends of the Herbarium
GBIF	Global Biodiversity Information Facility
GCN	Greatest Conservation Need
GFC	Tu-Hi Hong and Pum-Hi Hong Herbarium at Great Falls
GIS	Geographic Information System
GLAC	Glacier National Park Herbarium
GNP	Glacier National Park
GPI	Great Plains Institute
iDigBio	Integrated Digitized BioCollections
IDNHP	Idaho Natural Heritage Program
IPA	Important Plant Area Program
ITEK	Indigenous Traditional Ecological Knowledge
IUCN	International Union for Conservation of Nature
JACQ	jointly administered herbaria system of dozens of herbaria
LiDAR	Light Detection and Ranging
MDA	Montana Department of Agriculture
MEPA	Montana Environmental Policy Act

MFWP	Montana Fish, Wildlife & Parks
MISC	Montana Invasive Species Council
MNPS	Montana Native Plant Society
MONT	Montana State University Herbarium
MONTU	University of Montana Herbarium
MRC	Missoula Research Center Herbarium
MSUB	Montana State University Herbarium at Billings
MT/Dakotas BLM	Montana/Dakotas Bureau of Land Management
MTDEQ	Montana Department of Environmental Quality
MTDNRC	Montana Department of Natural Resources & Conservation
MTNHP	Montana Natural Heritage Program
MTNSN	Montana Native Seed Network
MUS	Montana University System
MWCA	Montana Weed Control Association
NEPA	National Environmental Policy Act
NF	National Forest
NGO	Non-governmental Organization
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRDP	Natural Resource Damage Program
NVCS	National Vegetation Classification System
NWR	National Wildlife Refuge
PSGIN	Plant Species of Greatest Inventory Need
PSOC	Potential Species of Concern
RAWA	Recovering America's Wildlife Act
RNA	Research Natural Areas
RTRL	Reserved Treaty Rights Lands
SEINet	regional network of North American herbaria
SFI	Sustainable Forestry Initiative
SHPO	State Historical Preservation Office
SO	Species Occurrence
SOC	Species of Concern
SSA	Species Status Assessment
SWAP	State Wildlife Action Plan
TEK	Traditional Ecological Knowledge
THPO	Tribal Historic Preservation Officers
TK	Traditional Knowledge
TNC	The Nature Conservancy
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USFS	United States Forest Service
WHIP	Wildlife Habitat Improvement Program
WMA	Wildlife Management Area
WNPS	Washington Native Plant Society
WPBR	White Pine Blister Rust
WRE	Wetland Reserve Easements
YELLO	Yellowstone National Park Herbarium
YNP	Yellowstone National Park

ONLINE RESOURCES CITED IN THIS STRATEGY

ASSOCIATIONS, LAND TRUSTS, CONSERVATION DISTRICTS, COUNCILS, & PRIVATE LAND STEWARDS

Centennial Valley Association https://www.centennialvalleyassociation.org

Gallatin Valley Land Trust https://gvlt.org/

Montana Association of Conservation Districts https://macdnet.org/

The Montana Conservationist https://macdnet.org/category/the-montana-conservationist/

Montana Association of Land Trusts https://montanalandtrusts.org/

Montana Rangelands Partnership http://montanarangelandspartnership.org/

Montana Rangelands Group https://storymaps.arcgis.com/stories/dca926ecbe044682b66767b4db176bd8

Montana Watershed Coordination Council https://www.mtwatersheds.org/

Watershed News https://www.mtwatersheds.org/resources/watershed-news/

Montana Weed Control Association https://www.mtweed.org/

North American Invasive Species Management Association (NAISMA) https://naisma.org/

SOCIETIES, CONSERVATION ORGANIZATIONS, & OTHER NON-PROFITS

Adventure Scientists https://www.adventurescientists.org/

American Society of Botanical Artists (ASBA) https://www.asba-art.org/

American Society of Landscape Architects (ASLA) https://www.asla.org/

An Assessment of Native Seed Needs and Capacities-2023 https://www.nationalacademies.org/our-work/an-assessment-of-native-seed-needs-and-capacities

California Native Plant Society (CNPS) https://www.cnps.org/

CNPS Field/Consulting Certified Botanist https://www.cnps.org/education/botanist-certification

Eriogonum Society https://eriogonum.info

Great Plains Institute (GPI) https://betterenergy.org/

Homegrown National Park https://homegrownnationalpark.org/about-us/

iNaturalist https://www.inaturalist.org/

International Union for Conservation of Nature (IUCN) https://www.iucn.org/

Montana Audubon Society https://mtaudubon.org

Montana Audubon Center (Master Naturalist Program) https://mtaudubon.org/center/

Montana Audubon Society Monthly E-News https://mtaudubon.org/news

Montana Discovery Foundation (Master Naturalist Program) http//www.montanadiscoveryfoundation.org/

Montana Native Plant Society (MNPS) https://mtnativeplants.org/

Conservation Committee https://mtnativeplants.org/conservation-issues/

Conservation Conference https://mtnativeplants.org/conservation-conference/

Germination of Wildland Collected Seeds https://mtnativeplants.org/wp-content/uploads/2022/03/MNPS-Wild-Seed-Germination-Paper-draft.pdf

Kelseya Archive https://mtnativeplants.org/archive/

Important Plant Areas (IPA) https://mtnativeplants.org/important-plant-areas/

Montana Native Plant Source Guide https://mtnativeplants.org/native-plant-landscaping/#

MNPS Collecting Guidelines https://mtnativeplants.org/wp-content/uploads/2018/07/MNPS-Guidelines-for-Collecting-Native-Plants-.pdf

MNPS Plant Collecting Guidelines for Teachers https://mtnativeplants.org/wp-content/uploads/2018/07/MNPS-Plant-Collection-Guidelines-for-Teachers.pdf

Native Plant Landscaping https://mtnativeplants.org/native-plant-landscaping/

Montana Natural History Center (Master Naturalist Program) https://www.montananaturalist.org/

Northwest Lichenologists' Certification https://northwest-lichenologists.wildapricot.org/page-1854204

***Penstemon* Society** https://penstemons.org/index.php

Plant Conservation Alliance https://www.plantconservationalliance.org/welcome

Pollinator Partnership https://pollinator.org/guides

- **Pollinator Steward Certification** https://www.pollinator.org/psc

Pull Your Share Movement https://www.pullyourshare.com/

Society for Range Management https://rangelands.org

Sustainable Forestry Initiative https://forests.org/

Swan Valley Connections (Master Naturalist Program) https://www.swanvalleyconnections.org/

The Nature Conservancy (TNC) https://www.nature.org/en-us/

- The Nature Conservancy Magazine https://www.nature.org/en-us/magazine/

The Wildlife Society https://wildlife.org/

Washington Native Plant Society https://www.wnps.org/plant-lists

Xerces Society https://www.xerces.org/pollinator-resource-center

BOTANIC GARDENS

Botanic Gardens Conservation International (BGCI) https://www.bgci.org/

- BGCI Global Strategy for Plant Conservation https://www.bgci.org/our-work/inspiring-and-leading-people/policy-and-advocacy/the-global-strategy-for-plant-conservation/

Denver Botanic Gardens https://www.botanicgardens.org/

- Strategy for Alpine Plant Conservation https://alpinestrategy.org/

State of Montana Arboretum https://www.umt.edu/arboretum/

University of Washington Botanic Gardens https://botanicgardens.uw.edu/

- Rare Care https://botanicgardens.uw.edu/science-conservation/rarecare/

HERBARIA, CONSORTIUMS, & SUPPORTING ORGANIZATIONS

Bitterroot National Forest Herbarium (BNFH) https://nansh.org/portal/collections/misc/collprofiles.php?collid=119

Consortium of Bryophyte Herbaria (CBH) https://bryophyteportal.org/portal/

Consortium of Lichen Herbaria (CLH) https://bryophyteportal.org/portal/

Consortium of Northern Great Plains Herbaria (CNGPH) https://ngpherbaria.org/portal/

Consortium of Pacific Northwest Herbaria (CPNWH) https://www.pnwherbaria.org/data/search.php

Glacier National Park Herbarium (GLAC) https://www.nps.gov/glac/learn/historyculture/collections.htm

Index Herbarorium https://sweetgum.nybg.org/science/ih/

JACQ (jointly administered herbaria system) https://www.jacq.org/

Rae Selling Berry Seed Bank https://www.pdx.edu/seed-bank/

SEINet (regional network of North American herbaria) https://symbiota.org/seinet/

University of Montana Herbarium (MONTU) https://hs.umt.edu/herbarium/default.php

- How to Press a Plant https://www.umt.edu/herbarium/documents/education/how-press-plants.pdf
- Friends of the University of Montana Friends Herbarium (FOH) https://www.umt.edu/herbarium/friends-of-the-herbarium/

Yellowstone National Park (YELLO) Herbarium https://www.nps.gov/yell/learn/nature/herbarium.htm

DATA AGGREGATORS

Global Biodiversity Information Facility (GBIF) https://www.gbif.org/

iDigBio https://www.idigbio.org/

OTHER RESOURCES: PUBLICATIONS, VIDEO, TRAINING, CERTIFICATION, & TOOLS

Fire in the West: Aspen & Fire, A Burning Issue https://www.youtube.com/watch?v=6A3LLWW6evk

Guide to Quaking Aspen Ecology and Management with emphasis on BLM Lands in the Western US https://qcnr.usu.edu/western-aspen-alliance/files/aspen-field-guide.pdf

LANDFIRE (a program of the USDI and USDA-FS) https://landfire.gov/index.php

Measuring and Monitoring Plant Populations (Elzinga et al. 1998) https://www.ntc.blm.gov/krc/legacy/course/265

Montana Climate Assessment 2017 and 2021 reports https://montanaclimate.org/

Climate Wizard https://www.climatehubs.usda.gov/hubs/southwest/tools/climate-wizard

Northwest Lichenologists' Certification https://northwest-lichenologists.wildapricot.org/page-1854204

Montana Native Plants for Pollinator-Friendly Plantings https://www.nrcs.usda.gov/plantmaterials/mtpmcbr11694.pdf

US National Vegetation Classification https://usnvc.org/

Wetland Training Institute https://wetlandtraining.com/

MONTANA TRIBES, SUPPORTING ORGANIZATIONS, & PUBLICATION

Apsaalooke Nation (Crow Tribe) http//www.crow-nsn.gov

Blackfeet Nation https://blackfeetnation.com/

Chippewa Cree Tribe of Rocky Boy Montana www.facebook.com/ChippewaCree

Confederated Salish and Kootenai Tribes https://csktribes.org/

Fort Belknap Indian Community https://ftbelknap.org

Fort Belknap Partnership for Restoration https://www.blm.gov/programs/natural-resources/native-plant-communities/about-native-plants/montana/fortbelknap

Fort Peck Tribes https://fortpecktribes.org

Mission Mountains Youth Crew Program https://www.nationalforests.org/regional-programs/northern-rockies/mission-mountains-youth-crew-program

Montana Little Shell Chippewa https://montanalittleshelltribe.org/

Montana Governor's Office of Indian Affairs https://tribalnations.mt.gov/

Northern Cheyenne Tribe www.cheyennenation.com

The Status of Tribes and Climate Change Report (STACCWG 2021) https://www7.nau.edu/itep/main/docs/publications/ITEP.STACC.Report_2021.pdf

US Department of Justice Office of Tribal Justice-Native American Policies https://www.justice.gov/otj/native-american-policies

STATE & FEDERAL SERVICE ORGANIZATIONS

Americorps State Programs in Montana https://serve.mt.gov/americorps/ameriCorps-programs

Montana Conservation Corps https://www.mtcorps.org/

NATURAL HERITAGE PROGRAMS & NETWORK

Idaho Natural Heritage Program https://idfg.idaho.gov/conservation/natural-heritage-program

Montana Natural Heritage Program (MTNHP) https://mtnhp.org/

Map Viewer https://mtnhp.org/mapviewer/

Montana Field Guide https://fieldguide.mt.gov/

NatureServe https://www.natureserve.org/

NatureServe Explorer https://explorer.natureserve.org/

US National Vegetation Classification https://usnvc.org/

Nebraska Natural Heritage Program https://outdoornebraska.gov/conservation/conservation-efforts/natural-heritage-program/

UNIVERSITIES

Montana State University Extension Services https://www.montana.edu/extension/localoffices.html

- Schutter Diagnostic Lab https://www.montana.edu/extension/diagnostics/

Portland State University

- Rae Selling Berry Seed Bank https://www.pdx.edu/seed-bank/

Utah State University

- Western Aspen Alliance https://qcnr.usu.edu/western-aspen-alliance/
- WAA Aspen Briefs https://qcnr.usu.edu/western-aspen-alliance/briefs/

University of Montana

- State of Montana Arboretum https://www.umt.edu/arboretum/

University of Washington

- Rare Care https://botanicgardens.uw.edu/science-conservation/rarecare/

STATE OF MONTANA AGENCIES

Institute of Museum and Library Science https://www.imls.gov/

Montana Department of Agriculture (MDA) https://agr.mt.gov/

- Montana Noxious Weed Management Plan https://agr.mt.gov/_docs/NWTF-docs/MT-Noxious-Weed-Management-Plan--Update-2017.pdf
- Montana Weed Control Association https://www.mtweed.org/

Montana Department of Commerce

- Montana Resiliency Plan https://redesign-commerce.mt.gov/Business/Programs-and-Services/Tourism-Marketing/Tourism-Grant-Program/Resiliency-Plan-Implementation-Grant-Program

Montana Department of Environmental Quality https://deq.mt.gov/

- Montana Wetland Council https://deq.mt.gov/Water/Programs/wetlands

Montana Department of Natural Resources and Conservation (DNRC)

- Conservation Seedling Nursery https://dnrc.mt.gov/Forestry/Conservation-Nursery/
- Forestry Assistance and Trust Lands Division https://dnrc.mt.gov/TrustLand/
- Montana Forest Action Plan (Montana Forest Action Advisory Council 2020) https://dnrc.mt.gov/_docs/forestry/Montana_Forest_Action_Plan_12.22.2020.pdf
- Montana Native Seed Network https://dnrc.mt.gov/Forestry/Conservation-Nursery/Native-Seed-Program

Montana Fish, Wildlife and Parks (MFWP)

- Candidate Conservation Agreement and Assurances https://fwp.mt.gov/conservation/fisheries-management/arctic-grayling
- CleanDrainDry https://fwp.mt.gov/conservation/aquatic-invasive-species
    - Future Fisheries Improvement Program https://fwp.mt.gov/ffip
- Habitat Conservation Lease Program https://fwp.mt.gov/conservation/habitat/habitat-conservation/lease-program
- Habitat Montana https://fwp.mt.gov/conservation/landowner-programs/habitat-montana
- Migratory Bird Wetland Program https://fwp.mt.gov/conservation/habitat/migratory-bird-wetland-program
- Montana WILD https://fwp.mt.gov/education/montana-wild
- PlayCleanGo https://playcleango.org/
- State Wildlife Action Plan (MFWP 2015) https://fwp.mt.gov/binaries/content/assets/fwp/gisresources/docs/swap/70169.pdf
- Wildlife Habitat Improvement Program https://fwp.mt.gov/aboutfwp/grant-programs/wildlife-habitat-improvement

Montana Historical Society https://mhs.mt.gov/

- Montana the Magazine of Western History https://mhs.mt.gov/pubs/Magazines/
- The Montana Historic Preservation Plan, 2023-2027 https://mhs.mt.gov/Shpo/docs/MontanaStatePlan_2023_2027.pdf

Montana Invasive Species Council https://invasivespecies.mt.gov/misc/about-us

Montana Department of Labor & Industry https://dli.mt.gov/

FEDERAL AND INTERNATIONAL GOVERNMENT & SUPPORTING NON-PROFIT ORGANIZATIONS

National Forest Foundation https://www.nationalforests.org/

National Science Foundation https://www.nsf.gov/

National Sustainable Agriculture Coalition https://sustainableagriculture.net/

What is the Farm Bill https://sustainableagriculture.net/our-work/campaigns/fbcampaign/what-is-the-farm-bill/

Natural Resources Conservation Service (NRCS) https://www.nrcs.usda.gov/

ACEP ALE and WRE https://www.nrcs.usda.gov/programs-initiatives/acep-agricultural-conservation-easement-program/montana/agricultural

Bridger Plant Materials Center, Montana https://www.nrcs.usda.gov/plant-materials/mtpmc

Montana Native Plants for Pollinator-Friendly Plantings https://www.nrcs.usda.gov/plantmaterials/mtpmcbr11694.pdf

Plant Conservation Alliance https://www.plantconservationalliance.org/welcome

United Nations. 2023. What is Climate Change? https://www.un.org/en/climatechange/what-is-climate-change

US Department of Agriculture (USDA) - Agriculture Research Service https://www.ars.usda.gov/pacific-west-area/pullman-wa/plant-germplasm-introduction-and-testing-research/docs/facilities-pullman-seed-storage/

US Forest Service (USFS)

Celebrating Wildflower Program https://www.fs.usda.gov/managing-land/wildflowers

Climate Change Vulnerability and Adaptation in the Northern Rockies https://www.fs.usda.gov/rm/pubs_series/rmrs/gtr/rmrs_gtr374_1.pdf

Montana Discovery Foundation http//www.montanadiscoveryfoundation.org/

Celebrating Wildflowers https://www.montanadiscoveryfoundation.org/programs/celebrating-wildflowers/

Adopt-A-Species https://www.montanadiscoveryfoundation.org/programs/adopt-a-species/

Native Plant Materials Strategic Framework (2012) https://www.fs.usda.gov/wildflowers/Native_Plant_Materials/policy.shtml

Native Plant Restoration Program https://www.fs.usda.gov/wildflowers/Native_Plant_Materials/policy.shtml

Pollinators and native Wildflowers https://www.fs.usda.gov/wildflowers/pollinators/

Rocky Mountain Research Station https://www.fs.usda.gov/rmrs/groups/western-center-native-plant-conservation-and-restoration-science

Vipond Park https://www.fs.usda.gov/wildflowers/regions/northern/VipondPark/index.shtml

Bureau of Indian Affairs (BIA) https://www.bia.gov/

Bureau of Land Management (BLM)

Fort Belknap Partnership for Restoration: https://www.blm.gov/programs/natural-resources/native-plant-communities/about-native-plants/montana/fortbelknap

Seeds of Success Guides and Training Resources https://www.blm.gov/programs/natural-resources/native-plant-communities/native-plant-and-seed-material-development/collection

National Seed Strategy-Business Plan https://www.blm.gov/sites/blm.gov/files/uploads/programs_natural-resources_native-plant-communities_national-seed-strategy_NSS-BUSINESS-PLAN.pdf

National Seed Strategy-Rehabilitation and Restoration https://www.blm.gov/sites/default/files/docs/2020-12/NationalSeedStrategy_2015-2020.pdf

US Department of Justice Office of Tribal Justice-Native American Policies https://www.justice.gov/otj/native-american-policies

US Fish and Wildlife Service (USFWS)

Pollinators https://www.fws.gov/initiative/pollinators

Endangered Species https://www.fws.gov/program/endangered-species

Recovery Outline for Whitebark Pine **Link will be removed when Recovery Plan is posted. https://ecos.fws.gov/docs/recovery_plan/20221215_WBP_Final_Recovery_Outline_v11_DRDsigned.pdf

US National Park Service https://www.nps.gov/index.htm

GLOSSARY

Advancing Succession:
The process of change in the species composition, structure, or architecture of vegetation in an ecological community over time. In the absence of disturbance, vegetation succession advances when one community type gives way to another community type.

Area of Critical Environmental Concern (ACEC):
The ACEC program was established in the 1976 Federal Lands Policy and Management Act and is managed by the Bureau of Land Management (BLM). Places designated as ACECs require special management to protect important historical, cultural, and scenic values, fish and wildlife, or other natural resources (BLM 2021). An ACEC is a type of Research Natural Area (RNA).

Biodiversity:
Short for biological diversity. The variety of life on Earth at all levels, from genes to ecosystems, that encompass the evolutionary, ecological, and cultural processes that sustain life. Biodiversity is usually measured in the number of species, but can be quantified by genetic variability, ecosystem diversity, and phylogenetic diversity.

Botanical Capacity:
The human, scientific, technological, organizational, institutional, and resource capabilities that support plant-based education and training, basic and applied research and environmental monitoring and management. See Box 3-1 in Section 3 for an interpretation used by the authors of this Strategy.

Botanist:
A person who engages in botany.

Botany:
Botany, a branch of biology that deals with the study of plants – cultivated or wild - including their structure, properties, and biochemical processes. It includes plant classification, plant diseases, and plant interactions with the environment. Traditionally, botany includes the study of fungi and algae.

Browse; Browsing:
A type of herbivory in which a herbivore feeds on leaves, soft shoots, or fruits of high-growing, generally woody plants (shrubs and trees).

Citizen Botany Program:
See MTNHP-MNPS Citizen Botany Program

Climate Change:
A change in the average weather condition that persists over multiple decades or longer. Climate change can encompass both increases and decreases in temperature, shifts in precipitation, changing risk of severe weather types, and other features of the climate system. The term encompasses other atmospheric changes, such as accelerated levels of carbon dioxide (CO2) and ozone depletion.

Climate Change Vulnerability Index (CCVI):
An index developed by NatureServe that uses a scoring system to integrate the species' predicted exposure to climate change within a defined assessment area (Montana). The index examines four elements: exposure to local climate change; indirect exposure to climate change; species-specific sensitivity; and documented or modeled responses to climate change. See also Tables 4-1 and 4-2 and Box 4-3 in Section 4.

Climax (Species):
A plant species that in forest succession is more adapted to a stable and predictable environment. As long as the site remains undisturbed climax species are likely to persist. Also called a late-seral, late-succession, K-selected, or equilibrium-species.

Collaborative Network (CN):
A partnership of autonomous people and organizations, supported by a computer network, that cooperate to share resources, such as data and connectivity. Herbaria that are part of a CN share data, such as specimen images, locations,

and label information, with other herbaria and research institutions.

Collections Manager (Herbarium):
A person who manages the herbarium. The person responsible for the long-term care of the herbarium and physical facilities for storage, including policy, access, specimen loans, digitizing, databasing, budgets, pest management, staff, and more. An herbarium may combine or separate the job of curator and collections manager. Compare with curator.

Conservation:
The management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations, while maintaining its potential to meet the needs and aspirations of future generations. Conservation is positive and embraces preservation, maintenance, sustainable utilization, restoration, and enhancement of the natural environment.

Consortium:
An agreement, combination, or group (as of herbaria) formed to undertake an enterprise beyond the resources of any one member. A Consortium of Herbaria can be regional, national, or international. It uses a collaborative network to unite specimen data from individual herbaria into a single database that is accessible by the public through an online portal.

Corolla:
The collective petals of the flower. The corolla encircles the reproductive organ(s) of a flower.

Cultural Burning:
A cultural fire practice used by Indigenous peoples to improve the vitality, resilience, or health of grasslands, forests, and other habitats.

Curator (Herbarium):
A person who conducts collection-based research and direct management of the herbarium collections. A curator preserves the botanical specimen, performs plant identification, collects or collaborates with others to obtain specimens, manages the collections, and much more. An herbarium may combine or separate the job of curator and collections manager. Compare with collections manager.

Demography, Demographic (Plant):
Plant demography is the science of studying a plant species' population and how population characteristics change through time. Observed, mapped, or measured population characteristics include, but are not limited to: total plant count; number and size of flowers and fruits; number of vegetative individuals; location of individuals; and number of seedlings.

Ecological Resilience:
The capacity of a species, habitat, plant community, or ecosystem to respond to a perturbation or disturbance by resisting the damage and subsequently recovering. Disturbances of sufficient magnitude or duration can profoundly affect the natural system, forcing it to reach a threshold beyond which a different regime of process or structure predominates.

Ecological System:
A biological community or major grouping that re-occurs across the landscape in similar physical environments and is influenced by similar (yet dynamic) ecological processes, such as fire or flooding. Ecological Systems are mappable and tend to be intuitive to non-ecologists.

Ecotype:
A genetically distinct population of a species that is adapted to local or regional environmental conditions. The distinct population may exhibit morphology or physiology that differs from other populations of the same species across its range. Individuals of an ecotype can reproduce with other ecotypes of the same species and produce fertile offspring.

Endangered:
A term used in the Endangered Species Act and defined as "any species which is in danger of extinction throughout all or a significant portion of its range."

Ethnobotany:
The study of interrelations between humans and plants. The study of how people of a particular culture or region make use of indigenous (native) plants for foods, medicines, clothing, religious rituals, or other uses.

Exotic Species:
As used in this Strategy are species, varieties, subspecies, or hybrids that have deliberately or accidentally been introduced, usually through human activities, to areas (Montana) that are outside their native geographic range. Mechanisms to control their populations are lacking. Exotic species may or may not become established where introduced. As defined by others, exotic species are not yet reproducing in their new range. Also called non-native or invasive. Compare with non-native.

Extinct; Extinction:
A species that has no known living individuals in captivity or the wild. The Strategy uses this term in reference to national or global extinction.

Extirpate; Extirpated; Extirpation:
A species that has no known individuals with a local or regionally defined area. The Strategy uses this term in reference to state (Montana) extirpation.

Floral Resource:
Pertaining to the things that flowers and flowering plants provide to animals. Some floral resource examples include nectar, pollen, physical flower, source for shelter, and source for dew (water). This term is also associated with the seasonal and spatial availability of flowering.

Foundation Species:
In ecology, a species that has a strong role in structuring a community. In comparison to a keystone species, foundation species physically modify the environment, produce and maintain habitats that benefit other organisms. Compare with keystone species.

Genetics:
The study of individual genes and their roles in inheritance.

Genetic (DNA) Sequencing:
The general laboratory technique for determining the exact order of nucleotides, or bases, in a DNA molecule. The sequence tells scientists the kind of genetic information that is carried in a particular DNA segment.

Genomics:
An interdisciplinary field of molecular biology that focuses on the structure, function, evolution, mapping, and editing of genomes. Genomics aims at the collective characterization and quantification of all of an organism's genes, their interrelations, and their influence on the organism.

Genome:
An organism's complete set of DNA including all of its genes as well as its hierarchical, three-dimensional structure configuration.

Global Rank (G-Rank):
A rank that indicates the overall risk to global extinction by collectively evaluating the plant's rarity, population trends, and level of threats.

Graze; Grazing:
A type of herbivory in which a herbivore feeds on grasses and other low growing plants (forbs, sedges, etc.)

Greatest Conservation Need (GCN):
A term used in State Wildlife Action Plans that can be applied to animals, plants, and plant communities; see definition.

Habitat:
The natural home or environment where a plant, animal, or other organism lives. A habitat provides the plant, animal, or other organism with food, water, shelter, and space to survive.

Habitat Enhancement:
The process to increase the suitability of a site for a desired species, according to what defines that species' habitat.

Habitat Type:
A classification system based on the natural relationships of species with abiotic and biotic

environmental conditions for a particular area. A type represents all of the land areas potentially capable of supporting similar plant communities at potential climax of the vegetation.

Herbarium (plural, Herbaria):
A room or building in which a collection of dried plants is systematically arranged and kept for preservation.

Herbarium Portal:
A website that functions as an entry point to the internet that specifically links online users to one or more herbaria and their associated data.

Herbivory:
The eating of plants by animals. Relative to this Strategy, ungulates and insects are common herbivores.

Human Environment:
As defined by the Montana Environmental Policy Act, it is the physical, biological, social, cultural, and economic components, conditions, and factors which interactively determine the state, condition and quality of living conditions.

Important Plant Area (IPA):
A program developed by Plantlife to provide a framework for identifying and maintaining the richest sites for plant life. An IPA is a non-legal designation. In Montana, an IPA is designated by the Montana Native Plant Society, where it supports an exceptional population of one or more globally rare plants or assemblage of rare or threatened plants in the state.

Index Herbariorum (IH):
A worldwide directory of individual herbaria. A qualifying herbarium registers and demonstrates that it maintains a permanent collection of botanical specimens that are accessible to scientists. The Index maintains information on each herbarium, such as its physical location, number of collections, status of digitization, types of organisms stored, founding date, contact information and area expertise of staff, herbarium acronym, and website address.

Indicator Species:
A species or group of species whose function, population, or status can reveal the qualitative status of the environment in a given locale. An indicator species can be a species of plant, animal, or microorganism. For example, Black Greasewood can be an indicator of saline soils.

Indigenous Knowledge (IK):
Indigenous Knowledge is a body of observations, oral and written knowledge, innovations, practices, and beliefs that developed from Tribes and Indigenous Peoples through interaction and experience with the environment. Compare with Indigenous Traditional Ecological Knowledge, Traditional Ecological Knowledge, and Traditional Knowledge.

Indigenous Traditional Ecological Knowledge (ITEK):
Indigenous Traditional Ecological Knowledge (ITEK) is a form of Indigenous Knowledge and one of many important bodies of knowledge that contributes to the scientific, technical, social, and economic advancements of the US to our collective understanding of the natural world. It is a body of observations, oral and written knowledge, practices, and beliefs that promote environmental sustainability and the responsible stewardship of natural resources through relationships between human and environmental systems. It is applied to phenomena across biological, physical, cultural, and spiritual systems. IK, ITEK, TEK, and TK is owned by the Indigenous peoples. Compare with Indigenous Knowledge, Traditional Ecological Knowledge, and Traditional Knowledge.

Invasive Species:
An exotic (non-native) species whose introduction does or is likely to cause harm to human health, economics, or the new environment. The term applies to the species and any biological material that is capable of propagating it, such as egg, spore, seed, and root. The Montana Invasive Species Council (MISC) is responsible for identifying priority invasive species issues and making recommendations to

improve management of invasive species. Many exotic and non-native species can be relatively benign in their impacts to the environment, but invasive species are not. See also exotic, non-native, and noxious.

Isotope Analysis:
The identification of an isotopic signature and the abundance of certain stable isotopes of chemical elements within organic and inorganic compounds. Isotopic analysis can be used on herbaria specimens to reconstruct past environmental and climatic conditions.

Keystone Species:
A species that has a disproportionately large effect on its natural environment relative to its abundance. The species plays a critical role in maintaining the structure of an ecological community, affecting other plants and animals in the ecosystem, and helping to determine the types and numbers of various other species in the community. If the keystone species is removed, the entire ecosystem or the community may experience a dramatic shift. In comparison to a foundation species, keystone species strongly affect the composition of communities in an ecosystem. Compare with foundation species.

Metadata:
Data that provides information about other data, but not the content of the data itself. A herbarium specimen that is barcoded contains metadata (herbarium name, accession number, etc.) in addition to the specific information provided by the collector in the specimens' label.

Metamorphosis:
A profound change in form from one stage to the next in the life history of an organism. Example: the developmental changes of a caterpillar to the pupa and from the pupa to the butterfly.

Mitigation (environmental):
Legally mandated remediation for the loss of a protected species or ecosystem. Compare with restoration and remediation.

MNPS-MTNHP Citizen Botany Program:
A joint partnership between the Montana Natural Heritage Program (MTNHP) and Montana Native Plant Society (MNPS) to establish a Montana Citizen Botany Program designed to harness the energy and expertise of citizen botanists to obtain critical field-based botanical information. The concept of developing a Montana Citizen Botany Program has progressed with the completion of a pilot study conducted from 2022-2024.

Morphology:
A branch of biology that deals with the form and structure of animals, plants, and other organisms. Plant morphology studies the physical form and external structure of the plant. Examples: size, shape, and arrangement of leaves; type, shape and density of hairs; colors; textures; patterns of the veins.

Native Species:
A species (variety, subspecies, or hybrid) that naturally or historically occurred or currently occurs in a defined geographical area. Native vascular plants are those that were known to occur in Montana before European settlement, typically dated as prior to or at the time of the Lewis and Clark Expedition from 1803 to 1806.

Nomenclature (Plant):
A system of naming plants used in the science discipline. See also systematics and taxonomy.

Non-Native Species:
As used in this Strategy are species, varieties, subspecies, or hybrids that have deliberately or accidentally been introduced, usually through human activities, to areas (Montana) that are outside their native geographic range. Mechanisms to control their populations are lacking. Non-native species may or may not become established where introduced. Non-native is technically a better term than exotic in this Strategy. Also called exotic or invasive. Compare with non-native.

Non-Vascular Species:
A species of plant or fungus that lacks vascular

tissue (no xylem or phloem). Non-vascular plants include mosses, liverworts, and hornworts. Non-vascular fungi include lichens and true fungi. Compare with vascular.

Noxious Weed:
A plant designated by the Montana Department of Agriculture as ‘noxious’ because it causes harm to public health, agriculture, recreation, wildlife, or property in Montana. Noxious weeds are both an exotic and an invasive species; compare with exotic and invasive.

Occurrence:
See Species Occurrence.

Phenology:
The study of periodic events in biological life cycles and how these are influenced by seasonal and interannual variations in climate, as well as habitat factors (elevation, soil type, etc.). In plants, this can include flowering, leaf unfolding (budburst), seed-set. dispersal, and leaf fall in relation to climatic conditions.

Plant Blindness:
A proposed form of cognitive bias. When defined broadly it is the human tendency to ignore plant species in one’s own environment, to not recognize the importance of plant life to human affairs or on Earth, to think plants are inferior to animals, or the inability to appreciate the unique features and aesthetics of plants. When defined more specifically, it is the inability to distinguish the differences between plant species in one’s own environment.

Plant Community of Greatest Conservation Need:
A Plant Community of Greatest Conservation Need (GCN) is designated by the partnership that developed this Strategy and information is managed by the Montana Natural Heritage Program. A Plant Community of GCN in Montana exhibits the following elements: 1) fits the definition of a plant community, 2) is widespread and common in Montana, 3) is composed of smaller vegetation types, 4) provides ecosystem services, 5) is facing a significant threat that can be identified, and 6) spans multiple land managers in different parts of Montana. The Montana State Wildlife Action Plan of 2015 uses a similar term, Community Type of Greatest Conservation Need (CTGCN).

Plant Species of Greatest Conservation Need:
A Plant Species of Greatest Conservation Need (GCN) is designated by the partnership that developed this Strategy and is information is managed by the Montana Natural Heritage Program. A Plant Species of GCN is a vascular plant that is either a Montana Species of Concern (SOC) or a non-SOC that is ‘of management concern’. See also vascular plant Species of Concern, vascular Non-SOC plant of management concern, Priority 1 and 2, and Box 4-1, Section 4 of Strategy.

Plant Species of Greatest Inventory Need (PSGIN):
Vascular plant Species of Concern that are poorly documented, and for which information is needed and obtainable.

Pollination:
The transfer of pollen grains from the anther (male) to the stigma (female) of the pistil. Depending upon the plant species, pollination occurs within a single flower or between separate flowers.

Pollinator:
Any animal that moves pollen from the anther to the stigma portions of a flowering plant. Common pollinators include, but are not limited to bees, wasps, moths, butterflies, birds, flies, bats, ants, and small mammals.

Pollinator-Friendly Plants:
Native plant species that have high visitation rates by bees and attract the greatest number of bee species or support specialist bee species. These plant species may also bloom for extended periods across the landscape. thereby increasing floral resources for pollinators.

Pollinizer:
A plant that provides (is the source of) pollen.

Potential Species of Concern (PSOC):
Native species, varieties, or subspecies for which current, often limited, information suggests a potential for vulnerability to extirpation in Montana. The PSOC term is a State of Montana designation determined by the Montana Natural Heritage Program.

Preservation:
Preservation is the protection of the environment from the harmful effects of human activity. In general, it is the act or process of keeping the species, unique habitat, or plant community in existence.

Priority 1 and 2 (Vascular Plant Species of Greatest Conservation Need):
(Vascular) Plant Species of Greatest Conservation Need (GCN) are further classified in this Strategy as Priority 1 or Priority 2. A Priority 1 species has more rigorous observation and mapping data, some monitoring or research, and/or biological literature. A species-specific conservation profile can be more easily written for Priority 1 species. A Priority 2 species either has less published research and literature about them, beyond accurate observation data and moderately precise mapping or is of GCN in association with a Unique Habitat or Plant Community of GCN. A species-specific conservation profile may not be completed for Priority 2 plants.

Propagule:
Any cellular structure produced by an organism that is capable of dispersing and surviving in the environment before developing into a new individual. Examples are seeds, spores, and cysts. Plant cuttings are sometimes regarded as artificial propagules.

Rare Plants:
Rare plant species exhibit small population sizes, narrow geographic ranges, affinities to unique habitats, have low reproductive rates, and/or declining distributions or populations. They are often at risk of extirpation in Montana, or possibly worldwide.

Recovery Plan (Endangered Species Act):
A document developed by the USFWS for species that are federally listed as threatened or endangered under the Endangered Species Act. A species recovery plan describes the current status, threats and intended methods for increasing rare and endangered species population sizes. Recovery plans act as a foundation from which to build a conservation effort to preserve the plant or animal and prevent its extinction.

Rehabilitation:
Rehabilitation is making the land useful again after a disturbance. It involves the recovery of ecosystem functions and processes in a degraded habitat. Rehabilitation does not necessarily re-establish the land to a pre-disturbance condition, but it does support returning it to a natural ecosystem state.

Remediation:
Remediation is improving an existing ecosystem or creating a new one with the aim of replacing another that has deteriorated or been destroyed.

Restoration:
The manipulation of the physical, chemical, and/or biological characteristics of a site with the goal of returning the majority of native organisms and natural functions to the lost or degraded native habitat.

Revegetation:
The establishment of vegetation on sites where it has been previously lost, often done with erosion control as the primary goal. Revegetation may or may establish plants that are native species to the area or that were present prior to their removal or loss.

Root Crown:
The upper portion of the root system from which a stem arises. A root crown area usually appears swollen, tapered, constricted (very thin), or as a combination of these. The root crown area is usually located near or at the soil level and is vaguely or clearly apparent.

Seral Community:
An intermediate stage found in the ecological succession of vegetation that advances towards its climax plant community.

Species Occurrence (SO):
A discrete area where the plant or animal is found or historically was documented based on direct observation(s). An SO is mapped as a polygon and may contain both the species and documented habitat. The Montana Natural Heritage Program defines and maps SOs for Species of Concern and Potential Species of Concern; it is similar to NatureServe's Element Occurrence (EO) except an SO is mapped at a finer scale.

Species Occurrence Rank (SO-Rank):
A rank that represents the overall "quality" of the Species Occurrence and is based on an assessment of the plant's population size, habitat quality, landscape context, and abiotic and biotic conditions. Updated and accurate SO ranks are used by managers in planning projects, prioritizing occurrences for restoration, identifying reference sites, and aiding in management decisions.

Species of Concern (SOC):
Native species, varieties, or subspecies that are at-risk due to declining population trends, threats to their habitats, a restricted distribution, and/or other factors. The SOC term is a State of Montana designation determined by the Montana Natural Heritage Program.

Species of Greatest Conservation Need:
A term used in State Wildlife Action Plans. See Plant Species of Greatest Conservation Need, vascular Plant Species of Concern, and vascular non-SOC plant of management concern.

Species of Greatest Inventory Need (SGIN):
A term used in State Wildlife Action Plans. See Plant Species of Greatest Inventory Need, Plant Species of Greatest Conservation Need, and vascular plant Species of Concern.

Specimen (Botanical):
An individual plant, fungus, or algae that is preserved for scientific long-term study. A vascular plant specimen is pressed, dried, and mounted with glue onto large, acid-free sheets of paper. Affixed to the sheet is a label of information that includes the plant's scientific name, collection location and habitat, collector's name and date, and other associated details. Non-vascular plants, fungi, and algae are typically preserved using other techniques.

State Threat Score:
The magnitude at which a species is observed, inferred, or suspected to be directly or indirectly negatively impacted by identified activities and/or processes (threats) at the statewide level. State Threat Score is assigned by the Montana Natural Heritage Program.

State Wildlife Action Plan:
A State Wildlife Action Plan is developed by a US state or territory for the purpose of conserving wildlife and habitat before it becomes too costly to restore and to prevent species from being listed under the Endangered Species Act. The plans are reviewed and approved by the US Fish and Wildlife Service and revised on a 10-year cycle. Montana's most recent SWAP was developed by Montana Fish, Wildlife & Parks in 2015; the next revision is in 2025. Approved plans are eligible to receive federal funds for species classified as Greatest Conservation Need (GCN). Some SWAPs have adopted plants as Species of GCN.

Stewardship:
The careful and responsible management of something entrusted to one's care.

Subnational Rank (S-Rank):
A rank that indicates the overall risk to state extirpation by collectively evaluating the plant's rarity, population trends, and level of threats. The S-Rank is commonly referred to as the species' State Rank. In Montana the Subnational Rank is determined by the Montana Natural Heritage Program.

Systematics (Plant):
Systematics is the study of relationships among organisms and the classification and naming of these organisms. Plant systematics addresses botanical species in the Plant, Fungal, and Algal Kingdoms. See also nomenclature and taxonomy.

Taxonomy (Plant):
Plant taxonomy is the science of classifying and naming plants. It is a branch of what is known as systematics, which is the science of determining how different biological organisms are related to each other. Taxonomy classifies plants and other organisms into different taxonomic levels. See also nomenclature and systematics.

Taxon (plural, Taxa):
A taxonomic group of any rank given formal recognition in a classification hierarchy, such as class, order, family, genus, species, variety.

Traditional Ecological Knowledge (TEK):
An accumulating body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (human and non-human) with one another and with the environment. It encompasses the world view of indigenous people which includes ecology, spirituality, human and animal relationships, and more. Compare with Indigenous Knowledge, Indigenous Traditional Ecological Knowledge, and Traditional Knowledge

Traditional Knowledge (TK):
Knowledge, know-how, skills, and practices that are developed, sustained, and passed on from generation to generation within a community, often forming part of its cultural or spiritual identity. Compare with Indigenous Knowledge, Indigenous Traditional Ecological Knowledge, and Traditional Ecological Knowledge.

Threat:
The proximate activity or process that has caused, is causing, or may cause destruction, degradation, and/or impairment to the target plant. Threats may be related to human activities or may be natural.

Threatened (T); Federally-Threatened:
A term used in the Endangered Species Act, and defined as "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range."

Tribal Sovereignty:
The inherent right of American Indians and Alaska Natives to govern themselves, and any decisions that could impact their property or citizens must be made with their participation and consent.

US National Vegetation Classification (USNVC):
The U.S National Vegetation Classification (USNVC) is a comprehensive classification system for all vegetation types in the United States. Much like a flora for plant species, the USNVC offers a hierarchy of classification levels from coarse to fine, providing a common language for the effective management and conservation of plant communities in the US. It is governed by standards for vegetation data collection and analysis, ensuring consistent reporting on the nation's vegetation resources.

Ungulate:
Mammals that are four-footed and hoofed. In Montana, ungulates include wildlife (bighorn sheep, deer, elk, mountain goats, moose, and bison) and domesticated animals (sheep, swine, cows, cattle. and horses).

Unique Habitats of Greatest Conservation Need:
A Unique Habitat of Greatest Conservation Need (GCN) is designated by the partnership that developed this Strategy and information is managed by the Montana Natural Heritage Program. A Unique Habitat of GCN in Montana exhibits the following elements: 1) spatially limited in Montana, 2) formed under unusual conditions or combinations of geology, hydrology, soils, and/or other ecological factors, 3) are habitats for at least one plant Species of Concern or Potential Species of Concern which is partially or entirely restricted to those

conditions, and 4) may include at least one rare plant community (plant association, habitat type, or other).

Vascular Plant:
A plant that has specialized vascular tissues for the transport of water and minerals (xylem) and food (phloem). Vascular plants are trees, shrubs, forbs, grasses, ferns, club-mosses, and other beings. Compare with non-vascular.

Vascular Plant Species of Concern:
A vascular plant that meets the criteria for being designated as a Species of Concern by the Montana Natural Heritage Program. Vascular Plant Species of Concern that qualify as a (Vascular) Plant Species of Greatest Conservation Need (GCN) in this Strategy exhibit the following elements: 1) G1, G2, G3, or in combination, or S1, S2, S3, or in combination; and 2) faces a direct or indirect threat as determined by the Montana State Threat Score, or is associated with a Unique Habitat or Plant Community of GCN that faces a significant or highly probable threat, or is poorly documented/information needed [PSGIN]; and 3) lacks taxonomic problems or large location ambiguity. See also definitions for Plant Species of GCN and vascular non-SOC Plant. See also Box 4-1, Section 4 of Strategy.

Vascular Non-SOC Plant of Management Concern:
A vascular plant that is common or stable (not a Montana Species of Concern) in Montana as determined by the Montana Natural Heritage Program. A vascular non-SOC plant of management concern that qualifies as a (Vascular) Plant Species of Greatest Conservation Need in this Strategy is nominated by several Strategy partners representing different organizations and is "of management concern" because the species is facing significant threats and a potential (not documented) decline.

Wetland:
A distinct ecosystem that is flooded or saturated by water, either permanently or seasonally. Wetlands often support vegetation typically adapted for life in saturated soil conditions (hydrophytic vegetation) and develop hydric soils. Wetlands support both aquatic and terrestrial plant and animal species.

Wetland Mitigation:
The restoration, creation, or enhancement of wetlands to compensate for permitted wetland losses.

Wildcraft:
To collect, harvest, or separate by cutting, prying, picking, peeling, breaking, pulling, digging, splitting, or otherwise removing uncultivated plants or plant parts from their physical connection or point of contact with the ground or vegetation upon which they are growing or from the place or position where they lay for commercial purposes. The term "commercial purposes" means the harvest of wildcrafted plant material for the purpose of selling, trading, or otherwise exchanging the material for profit.

Wildland-Urban Interface (WUI):
A term commonly used in areas that experience wildfires. The zone of transition between unoccupied land and human development. It is the line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.

Photo Credit: Andrea Pipp

Photo E-2. Teaming together Montana's State Entomologist and members of the Montana Native Plant Society learn and share information on native plants, pollinators, and other insects that live in a grassland community. Priest Pass, Helena-Lewis and Clark National Forest, Montana.